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August 4, 2008

AFIN: 72-00171
Pmt #: 0205-SR-2
REC'D
SCAN ☒ AUG 04 2008
Doc ID#: 53452
To: MR File

SWMD

Mr. Bryan Leamons, PE
Technical Branch, Engineer Supervisor
Solid Waste Management Division
Arkansas Department of Environmental Quality
5301 Northshore Drive
Little Rock, AR 72118-5317

RE: Revised Phase 1 Work Plan
Northwest Arkansas Waste Management, Inc. ("Parsons") Landfill
Permit No. 0205-SR-2
FTN No. 3013-202

Dear Mr. Leamons:

FTN Associates, Ltd. (FTN) has revised the Phase 1 Work Plan for the Parsons Landfill and an electronic copy is attached. Comments from the correspondence between Arkansas Department of Environmental Quality and FTN, that were transmitted July 23 through 28, 2008 via email, have been incorporated into the revised work plan.

Your expedited review is appreciated. If you have any questions regarding the submittal of this report, please do not hesitate to contact me or Dianne Lincicome, PE, PG, at (501) 225-7779.

Respectfully submitted,
FTN ASSOCIATES, LTD.

Dianne Lincicome for

Paul Crawford, PE, PG
Project Manager

DEL/ack

Enclosures

CC: Clark McWilliams, PE; Arkansas Department of Environmental Quality (with enclosures)

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PHASE 1 WORK PLAN
LANDFILL CLOSURE AND POST-CLOSURE ACTIVITIES
NORTHWEST ARKANSAS WASTE MANAGEMENT, INC. ("PARSONS")
CLASS 1 LANDFILL
PERMIT NO. 0205-SR-2
AFIN: 72-00171

REVISED
AUGUST 1, 2008

PHASE 1 WORK PLAN
LANDFILL CLOSURE AND POST-CLOSURE ACTIVITIES
NORTHWEST ARKANSAS
WASTE MANAGEMENT, INC. ("PARSONS")
CLASS 1 LANDFILL
PERMIT NO. 0205-SR-2
AFIN: 72-00171

Prepared for

Arkansas Department of Environmental Quality
Solid Waste Management Division
5301 Northshore Drive
North Little Rock, AR 72118-5317

Prepared by

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

FTN No. 3013-202

REVISED
August 1, 2008

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1.0 INTRODUCTION

By an email correspondence dated April 11, 2008, the Arkansas Department of Environmental Quality (ADEQ) approved the Scope of Work prepared by FTN Associates, Ltd. (FTN) and requested that FTN prepare a Phase 1 Work Plan for the Northwest Arkansas Waste Management, Inc. ("Parsons") Landfill, a closed facility including both Class 1 and Class 4 landfills in Washington County, Arkansas.

The project team includes personnel from FTN, Wenck Associates, Inc. (Wenck), and the Center for Toxicology and Environmental Health, LLC (CTEH). FTN will be responsible for managing the overall project, conducting field investigations, performing data evaluation, developing remedial options, and preparing project reports. Wenck will assist FTN with the data evaluation, development of remedial options, and preparation of project reports. CTEH will conduct the risk evaluation. The objectives of the closure and post-closure activities for this site are to:

1. Determine to what extent the release of contaminants has impacted the subject property and surrounding property and groundwater/surface water in the vicinity;
2. Determine if landfill gas (LFG) is migrating offsite;
3. Determine the risks to human health and the environment associated with the contaminants; and
4. After site characterization is completed, depending on the findings, ADEQ will decide on design and implementation of remedial measures.

The Scope of Work includes completing the project initiation and planning, conducting field investigations, evaluating data and risk to human health and the environment, and preparing a closure and post-closure work activities report that includes recommended corrective measures.

2.0 SITE DESCRIPTION AND HISTORY

This section includes a general description of the Parsons site. A legal description is included, as well as a discussion of current site conditions.

2.1 Site Location and Legal Description

According to available records, the site is located on approximately 140 acres, approximately 3 miles east of Springdale and about 1 mile north of Highway 412 East, in Washington County, Arkansas, specifically the north half of Section 3, Township 17 North, Range 29 West of the Sonora quadrangle map (see Figure 2.1). The legal description of the property below is from the permit modification application for Phase III of the landfill and indicates the property is approximately 180 acres in area (which disagrees with acreage reported elsewhere):

> The southeast quarter of the northwest quarter of Section 3, containing 40 acres, more or less; the south half of the northeast quarter of the northwest quarter of Section 3 containing 20 acres, more or less, and the north half of the north half of the northeast quarter of the southwest quarter of Section 3, containing 10 acres, more or less, all in Township 17 North, Range 29 West.
>
> The fractional northwest quarter of the northeast quarter of Section 3, containing 33.06 acres, more or less; and the fractional south half of the northeast quarter of Section 3, LESS AND EXCEPT the following described tract: Beginning at the southwest corner of said 80-acre tract, and running thence north 676.8 feet; thence north 89 degrees 23 minutes east 708.5 feet; thence south 676.3 feet; thence south 89 degrees 23 minutes west 708.5 feet to the point of beginning, leaving 67.73 acres, more or less, all in Township 17 North, Range 29 West.
>
> The southwest quarter of the northeast quarter of the northeast quarter of Section 3, containing 10 acres, more or less. All in Township 17 North, Range 29 West.

2.2 Description of Current Conditions

Approximately 40 acres were originally permitted for waste disposal. The Class 4 landfill is located east of Area 1 of the Class 1 landfill as shown on Figure 2.1.

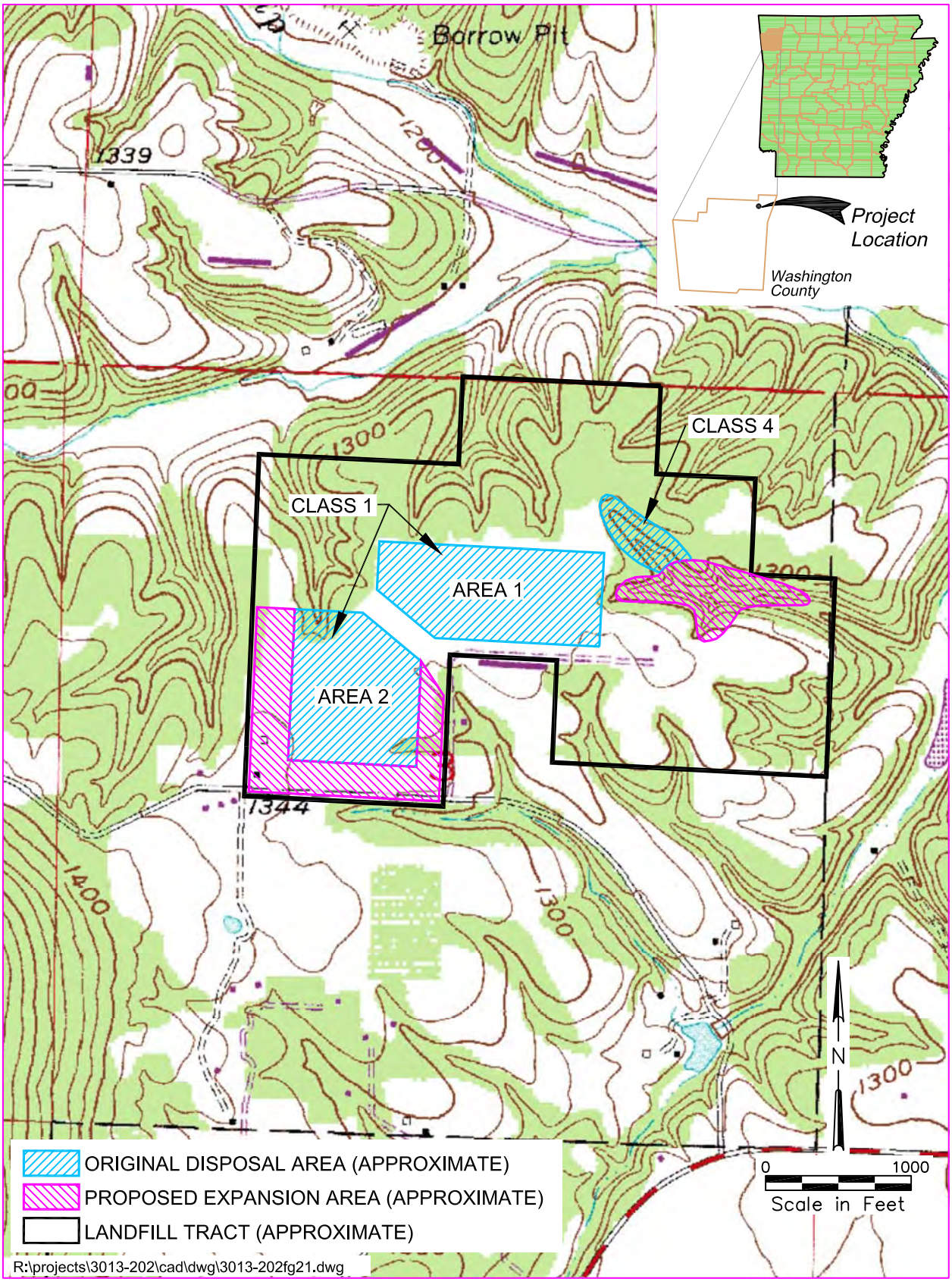

Figure 2.1. Disposal areas.

The site is currently being used to pasture cattle. The general topography of the Class 1 landfill area is relatively flat, but steep slopes and ravines bound portions of the site. Differential settling in the areas used for trench fill has resulted in an undulating surface with fissuring of the surface and depressions as deep as 10 ft. Gas vents and leachate wells (many are broken off or otherwise damaged) are located in the trench fill area. A 3-inch natural gas distribution line, owned and maintained by Arkansas Western Gas Company, crosses the site.

The surrounding land use is primarily rural with some residential, along with cattle and poultry production. Several single-family dwellings are located adjacent to the southern boundary of the Class 1 area.

2.2.1 Topography and Surface Water Flow Paths

The topographic relief of the site is about 100 to 120 ft. Part of the site lies at a local topographic high point. Surface water runoff flows radially from the topographic high point until it is intercepted by onsite ponds or natural drainages.

2.3 Site History

The original facility solid waste permit was issued to Harold Parsons of Springdale, Arkansas, in 1983 as the East Side Sanitary Landfill, covering areas for both putrescible wastes (Class 1) and non-putrescible wastes (Class 4). Mr. Harold Parsons is the owner of the property and the facility has historically been referred to as the "Parson's Landfill." The permit was subsequently transferred to Northwest Arkansas Waste Management, Inc. (prior to April 1985). The landfill facility was constructed before implementation of the Resource Conservation and Recovery Act (RCRA) Subtitle D or Arkansas Pollution Control and Ecology Commission (APCEC) Regulation No. 22 liner requirements. The facility received a water permit (No. 2835-W) on June 7, 1983, that authorized the facility to operate and discharge from a sediment pond located on the landfill site.

The Class 1 landfill was a trench-fill operation and the Class 4 landfill was a ravine-fill operation. A minor modification of the permit was approved by ADEQ on October 2, 1985, that renumbered the trenches and corresponding fill sequence and allowed for excavations with a

track hoe. The solid waste permit was modified on August 4, 1986, to allow for composting of municipal wastewater treatment sludge within the 40-acre permitted area on the condition that the composting operation did not overlie any previously-landfilled waste. ADEQ internal correspondence states that information submitted to the Water Division for modification of the water permit showed that the composting operation would be conducted outside the 40-acre permitted area. It is unknown at this time whether this issue was ever resolved or if composting operations were ever conducted at the site. In addition to being approved to accept wastewater treatment sludge, the landfill also received dissolved air flotation skimmings from Tyson Foods (also known as Ocoma Foods) at Berryville.

In two separate proposals, the facility apparently proposed to expand the Class 1 and Class 4 landfills in late 1988 or early 1989 (documentation is incomplete). The proposed area of expansion of the Class 1 landfill was to the east, south, and west of the permitted Area 2, expanding Area 2 from approximately 18.2 acres to 31.6 acres. The facility proposed to expand the Class 4 landfill to fill three additional ravines (Figure 2.1). It is unclear whether these expansions were ever approved or implemented.

The landfill has had a history of operational problems, leachate problems, and groundwater issues. Consent Administrative Order (CAO) LIS: 87-012, dated April 2, 1987, noted several violations related to trench construction, trench certification, and site operations and maintenance. The CAO required the facility to:

1. Install leachate collection capability in each of the existing trenches;
2. Prepare a report on the adequacy of the existing groundwater monitoring system;
3. Submit a permit modification application to reflect changes in final elevation and drainage modifications;
4. Cover, grade, and vegetate portions of the site that had received waste; and
5. Provide written certification of trench construction.

CAO LIS: 90-026 revoked the facility permit effective March 2, 1990. It is unknown when the last load of waste was taken to the facility. Capping and closure of the facility began in 1996, and in 1998 additional remediation of the initial cap and cover was performed by the city

of Fayetteville. The permit was voided by ADEQ on November 4, 1998. Since that time, problems associated with groundwater and surface water impacts, inadequate soil cover, lack of vegetative cover, erosion, differential settling, ponding of water, and methane gas generation have been noted by ADEQ (ADEQ 2005a).

3.0 ENVIRONMENTAL SETTING

3.1 Geology and Soils

The facility is located within the Springfield Plateau of the Ozark Highlands physiographic province. The uppermost geologic unit, as mapped by Ernest Glick (unpublished geologic worksheet) in 1970, indicates the site is located in the outcrop of the Mississippian-age Boone Formation. McFarland (1998) describes the Boone Formation and the St. Joe member of the Boone Formation as follows:

BOONE FORMATION/(LIMESTONE/CHERT)

Age: Early and Middle Mississippian Period

Distribution: Northern Arkansas, Ozark Plateaus; southwestern Missouri and eastern Oklahoma

Geology: The Boone Formation consists of gray, fine- to coarse-grained fossiliferous limestone interbedded with chert. Some sections may be predominantly limestone or chert. The cherts are dark in color in the lower part of the sequence and light in the upper part. The quantity of chert varies considerably both vertically and horizontally. The sequence includes an oolite member (Short Creek Member) near the top of the Boone Formation in western exposures and the generally chert-free St. Joe Member at its base. The Boone Formation is well known for dissolutional features, such as sinkholes, caves, and enlarged fissures. Crinoids are the most common fossil found in the formation, but brachiopods, bryozoa, mollusks, corals, shark material, trilobites, conodonts, and others fossils are known. The lower contact of the Boone Formation is considered disconformable in most places, but some workers suggest a conformable lower contact with the Chattanooga Shale; the contact with the St. Joe Member is conformable. The thickness of the Boone Formation is 300 to 350 feet in most of northern Arkansas, but as much as 390 feet has been reported.

Original reference: J.C. Branner and F.W. Simonds. 1891. Annual Report of the Geological Survey of Arkansas for 1888, v. 4. pp. xiii, 27-37.

Type locality: Named for extensive development in Boone County, Arkansas

ST. JOE LIMESTONE/MEMBER of the BOONE FORMATION

Age: Early Mississippian Period

Distribution: Northern Arkansas, Ozark Plateaus; Oklahoma, southern Missouri

Geology: The St. Joe Limestone is a fine-grained, crinoidal limestone that may occasionally contain some smoothly bedded chert. Some beds may display a coarse bioclastic texture. The limestones (and cherts) are frequently gray, but may also be red, pink, purple, brown, or amber. The fossil clasts are generally white in contrast to the matrix. Some thin calcareous shales are found in the sequence (top, lower middle, and base). The base of the St. Joe Limestone is generally marked by a phosphatic, greenish shale or conglomerate. It is a frequent bluff former. A formation rank has been suggested by some workers for the St. Joe Member of the Boone Formation. Crinoids, brachiopods, bryozoa, conodonts, blastoids, ostracods, and rugose coral have been noted in the unit. The basal contact is considered disconformable in most places, but some workers suggest a conformable lower contact with the Chattanooga Shale. The St. Joe Limestone ranges from a feather edge to over 110 feet in thickness.

Original Reference: T.C. Hopkins. 1893. Annual Report of the Geological Survey of Arkansas for 1890, v. 4.

Type locality: Named for exposures near St. Joe, Searcy County, Arkansas; principal reference section in a quarry 2 miles northwest of St. Joe (NE, NW, Section 18, Township 16 North, Range 17 West)

The Boone Formation is overlain by 35 to 60 ft of unconsolidated material described by Goodman (1985) as follows:

1. The general sequence of the strata underlying the landfill area is described as follows:
    a. Eight inches of brown to tan silty topsoil with grass roots and other organic material;
    b. One to nine feet of red/brown to tan silty clay with some borings containing cobble-sized, weathered chert;
    c. Approximately 10 ft of reddish tan to red clayey silt or silty clay with increasing amounts of chert fragments, seams (2 to 3 inches thick), and layers (6 to 18 inches thick) with depth. The chert was highly fractured, with fractures trending vertical to nearly vertical; and
    d. Approximately 15 to 30 ft of red gravelly, clayey silt with “dramatically” less chert than above.
2. Onsite soils are variable and have been classified according to the Unified Soils Classification System (USCS) as ML, MH, CH, CL, SC, GM, and GC.
3. Laboratory permeability testing of onsite soils yielded coefficients of permeability between 10^{-3} and 10^{-6} cm/sec, although modification in the gradation was necessary to prepare some samples for compaction.

Soils at the site are residual soils weathered from the Boone Formation. Soils in the Class 1 disposal area are identified primarily as Captina silt loam (CaC2) (USDA 1969) and are described as a silt loam or silty clay loam to a depth of about 20 inches, underlain by up to 3 ft of a brittle fragipan of silt loam or silty clay loam and then chert. The Captina soils are strongly acidic with a low to medium shrink-swell potential. Soils in the Class 4 disposal area are primarily identified as Baxter cherty silt loam (BaF) (USDA 1969). This type soil develops mainly on short steep hillsides bordering V-shaped valleys. The upper soils are cherty silt loam or silty clay loam that is underlain by fractured, partially weathered chert. The Baxter soils are also strongly acidic and have low to medium shrink-swell potential.

A prominent structural feature in the area is a normal northeast-southwest trending fault system known as the Fayetteville Fault. Multiple lineaments (including the Fayetteville Fault) and fracture traces have been identified in the vicinity of the site from aerial photos and topographic maps. One fracture trace passes between Areas 1 and 2 of the Class 1 landfill, with a northwest-southeast trend (Goodman 1985; Steele 1989). Two electrical resistivity survey profiles across this fracture trace indicated an anomaly corresponding to the location of the fracture trace. The anomaly was interpreted by Goodman (1985) to be minor fracture development along the fracture trace that was saturated to some depth below the bedrock surface. The presence of this fracture trace was considered in the design of the landfill by eliminating the placement of waste in this area.

3.2 Hydrogeology and Local Groundwater Use

Regionally, the groundwater flow direction in the Boone-St. Joe aquifer is to the east toward Beaver Lake (Goodman 1985). The direction of groundwater flow from the site has been reported as northeast (ADEQ 2005a) and radially away from the topographic high point (Steele 1989). In karst environments (e.g., the Boone Formation), the direction of groundwater flow is strongly influenced by jointing, fracturing, and associated solution features. Several seeps and springs have been identified in the vicinity of the landfill.

Depths to groundwater in monitoring wells at the site have been measured from about 60 ft to 90 ft below ground surface (bgs) (ADEQ 2005b). Goodman (1985) reported that borings

penetrating the bedrock surface encountered a thin zone of saturation (approximately 0.5 ft) perched above the bedrock and stated that flow within this zone is "predominantly lateral with vertical diffuse flow to the underlying Boone-St. Joe aquifer." Goodman (1985) concluded that data from onsite monitoring wells completed in the bedrock showed that the site is within a recharge area for the aquifer and presented evidence of a multiple flow system within the Boone-St. Joe aquifer at the site.

Susan Bolyard (a Masters-level student at the University of Arkansas) developed a conceptual hydrogeologic model for the site in her thesis entitled "Migration of Landfill Contaminants in a Tilted-Block Mantled Karst Setting in Northwestern Arkansas" (Bolyard 2007). As discussed in the thesis, Greg Stanton of the United States Geological Survey (USGS) performed geophysical logging of two water wells and two of the monitoring wells. Electrical resistivity transects were also conducted during the same investigation. Bolyard and others (2007) concluded that:

- Hydrogeological and geophysical data indicate a structural control bisecting the landfill that creates a hydrologic boundary and controls groundwater flow direction;
- Groundwater sampling results show contaminant migration along north-trending flow paths; and
- Local faulting has resulted in a hydrogeologic framework of tilted blocks with flow conduits at block surfaces that control groundwater gradient, flow directions, and ultimately contaminant migration.

Water wells in the vicinity of the landfill are completed in the Boone Formation. A deep well located on Price Mountain reportedly historically served the White River Rural Water Association and provided most households in the vicinity with water. A well search on the USGS website (http://nwis.waterdata.usgs.gov) identified two deep wells on the southwest flank of Price Mountain. The wells are located near one another about 1 mile from the site and the well depths are about 2,000 ft bgs. No information can currently be accessed concerning the White River Rural Water Association and it is unknown whether either of these wells is active or has been plugged/abandoned. Two private wells have reportedly been located within 0.25 mile of the landfill (as reported in Permit Modification Application for Phase III Expansion). One was

reportedly on site and provided water to the landfill operator's office. The location and status of the onsite water well is unknown. Goodman (1985) identified a drilled residential well about 200 ft south of Area 1 of the Class 1 landfill and a hand-dug well just outside the southwest corner of Area 2. It is unknown whether either of these wells corresponds to the wells reported to be within 0.25 mile in the Permit Modification Application (1988 or 1989) for expansion of the Class 1 landfill.

3.3 Surface Water

The original design of the landfill was to route surface drainage to several onsite ponds. The 1983 permit summary prepared by ADEQ for the site indicates that drainage from the site was supposed to be collected in three ponds with separate water permits. During the site visit in April 2007 by FTN and ADEQ, two ponds were located at the site. One pond is located on the south side of the two Class 1 waste disposal areas near an existing chicken house. The other pond is located on the extreme eastern portion of the property and may have been used as the retention pond for the Class 4 disposal area. The southern pond appears to drain to the northwest to a tributary of Friendship Creek and the eastern pond drains eastward and eventually to a tributary of Friendship Creek.

The study area is reportedly drained on the north by Friendship Creek and on the east and south by intermittent tributaries to Friendship Creek. Friendship Creek drains to its confluence with the White River, approximately 2 miles northeast of the facility. This portion of the White River is part of Beaver Lake, a major source of drinking water. Designated uses for the White River and Beaver Lake include primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and fisheries.

3.4 Ecological Systems

CTEH will complete ADEQ's "Checklist for Ecological Assessment/Sampling" for the landfill. As appropriate, a screening level ecological risk assessment (SLERA) will be conducted according to United States Environmental Protection Agency (USUSEPA) guidance.

4.0 PREVIOUS INVESTIGATIONS/DATA GAPS

A number of investigations have been conducted at the site since 1984. Available records for the site are limited in content and incomplete. FTN reviewed the information and data that were available from ADEQ files, compiled the information, and identified the data gaps described in this section.

4.1 Springs and Seeps

Brock Spring has been sampled on several occasions by ADEQ and metals exceeding USEPA Region 6 residential water Human Health Medium–Specific Screening Levels (HHMSSLs) have been measured, along with some volatile organic compounds (VOCs). Two other large springs within the Friendship Creek valley have been sampled. The Beaver Water District sampled one in April 1989, and ADEQ sampled both in August 2005. The 1989 sampling showed the presence of methylene chloride at the spring identified as Friendship Creek Spring No. 2. The 2005 samples from these springs did not show the presence of VOCs. Arsenic exceeded the Region 6 residential water HHMSSL in the two Friendship Creek springs, but other metals did not exceed water quality standards.

Several seeps have been located and sampled in the vicinity of the Parsons Landfill (ADEQ 2005b). GPS coordinates for five sampled seeps have previously been established by ADEQ. VOCs have been detected in samples from some of the seeps, with several VOCs exceeding their respective Maximum Contaminant Level (MCL) or Region 6 residential water HHMSSL. Existing spring/seep monitoring in the vicinity of the site has been inconsistent in terms of locations and parameters, and quality control/quality assurance (QA/QC) for some sampling events is not well documented.

4.2 Surface Water

In April 1989, the Beaver Water District sampled Friendship Creek Cove and methylene chloride was reported at a level of 1.1 parts per billion (ppb).

No information is currently available for surface water sampling in accordance with National Pollutant Discharge Elimination System (NPDES) permits at the site. A file review of ADEQ records should be conducted to document any records of surface water quality associated with the NPDES outfalls.

Stormwater outfalls need to be located and analytical data are needed to evaluate potentially hazardous constituents in the surface water migration pathway.

Analytical data should also be compared to APCEC Regulation No. 2 surface water quality standards.

4.3 Air

The design of the Class 1 trenches included the installation of two gas vents in each trench to allow LFG to escape to the atmosphere. Some of the gas vents are currently present at the site but many are damaged.

During a site reconnaissance that was performed by FTN on April 5, 2007, explosive gas was measured in gas vents and/or leachate wells. A reconnaissance of the status of existing gas vents (e.g., condition, total depth, depth to water, and methane concentrations) should be performed. The installation of gas monitoring probes at the perimeter of the site and other select locations is also warranted to determine if explosive gas measured onsite is migrating to offsite property or structures.

4.4 Geology and Soils

Wyndal Goodman of Ozark Geological Services, Inc. submitted a hydrogeologic investigation report to ADEQ on May 28, 1982, although the report cannot be located. A subsequent Masters-degree thesis by Mr. Goodman dated January 1985 and titled “A Hydrogeologic Evaluation of the Northwest Arkansas Waste Management Landfill, Washington County, Arkansas” includes the results of the initial hydrogeologic investigation, as well as supplemental investigations by Mr. Goodman. The report includes the results of soil borings, surface resistivity surveys, and dye tracing. A structural contour map of the top of the bedrock surface was developed from data at 14 boring locations. The Soil Conservation Service and

Cooper Consultants, Inc. (Cooper) of Bentonville conducted soils investigations at the site for Mr. Parsons in 1982.

McClelland Engineers, Inc. (McClelland) was retained by Washington County and submitted a report on March 28, 1983, after onsite testing of soils. Logs of the McClelland borings and laboratory data sheets are available.

Generalized boring logs are available in reports for some of the existing wells but standard boring logs for each well are not. Depth-to-bedrock and soil/bedrock characteristics are described in Goodman's thesis and other miscellaneous reports. Existing geologic information will be supplemented and refined with any additional information from borings advanced during subsequent investigations.

It is unknown whether an area at the site was ever used for wastewater sludge composting operations. If such an area can be located and delineated, this data gap should be addressed by collecting soil samples for analytical testing.

4.5 Groundwater

Six monitoring wells were installed at the site in 1983 and groundwater monitoring has been conducted at the site since 1984. Monitoring wells are reportedly completed in the Boone-St. Joe aquifer as open-hole boreholes below surface casing that typically extends about 10 ft into the bedrock. Original permit conditions specified the collection of samples from the six onsite wells (MW-1, MW-2, MW-3, MW-4, MW-5, and MW-6) for the analysis of iron, lead, zinc, cadmium, manganese, chloride, total dissolved solids (TDS), chemical oxygen demand (COD), pH, and total hardness. In compliance with permit conditions, the retention pond (east of the Class 4 area) at the site was also sampled for the same parameters. VOCs have been analyzed periodically at the site since March 1989.

Three wells were replaced in August 1989 at the request of ADEQ due to elevated turbidity and questionable integrity (MW-7 replaced MW-2, MW-8 replaced MW-3, and MW-9 replaced MW-4). Goodman reported in 1985 that monitoring well MW-1 was run over by a truck and damaged; it is unknown why this well was not replaced. There was reportedly some historical confusion regarding numbering of the monitoring wells, apparently between original

wells and the respective replacement well (samples for replacement wells were apparently labeled with the original well number). MW-2 was reportedly plugged and abandoned, but no documentation for decommissioning the other wells that were replaced is available. Three additional wells were also installed in August 1989 (MW-10, MW-11, and MW-12). New and replacement monitoring wells MW-8 through MW-12 range in depth from 102 ft to 140 ft bgs. The invoice from the driller (Dean Scantling Well Drilling) for drilling the replacement wells only indicated the installation of surface casing at monitoring wells MW-8 and MW-9, not at every new or replacement well. Other than the invoice, there is no available information regarding installation of these wells. At some point, monitoring well MW-13 was installed to replace MW-6. There is no available analytical data for MW-13.

Routine monitoring at the site has not been performed since 1990. Eight wells were located on site by ADEQ in July 2005, four of which were sampled (MW-5, MW-7, MW-8, and MW-9). Three of the wells (MW-1, MW-12, and MW-13) had submersible pumps in them at the time. MW-10 could not be located but the area was thickly vegetated at the time. The last documented sampling event was conducted by USGS in June 2006 (sampling of two monitoring wells, one spring, and three seeps). VOCs have been historically been measured in samples from monitoring wells MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, and MW-11. Measured concentrations of VOCs have exceeded the respective Region 6 residential water HHMSSL or MCL in samples from MW-5, MW-6, MW-8, and MW-9. Elevated metals (exceeding the respective MCL) have been measured in samples from monitoring wells MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, and MW-8.

A composite sample collected by Northwest Arkansas Waste Management from leachate wells at the site in 1989 showed relatively high concentrations of several VOCs.

Additional groundwater data is needed because:

- Much of the historical data for the site is of questionable quality because of a lack of QA/QC documentation and undocumented sampling procedures;
- There have been apparent errors in some of the units used for constituent concentrations in some reports; and
- Most sampling events have included a limited list of monitoring wells and/or constituents.

The existing groundwater monitoring system should be assessed and groundwater monitoring should be conducted to effectively determine groundwater quality in the vicinity of landfill and to determine direction of groundwater flow. Water supply wells in the vicinity of the landfill should be located and identified.

4.6 Sediments

There are no available data for sediments in the vicinity of the landfill to evaluate the nature and extent of contaminant migration along surface drainage pathways. This data gap should be addressed.

5.0 PROJECT APPROACH

Tasks at the site will be phased to evaluate data and refine subsequent tasks. The approved Phase 1 scope of work includes a site reconnaissance, one round of surface water sampling, surface soil sampling, one round of groundwater sampling at existing monitoring wells, leachate sampling, and conducting an aerial survey of the site. Following a review of Phase 1 activities and results, a detailed work plan and budget for the Phase 2 field investigations will be developed. The following general tasks are anticipated to be conducted during the Phase 2 investigation but may be modified after initial data is evaluated:

1. Hydrogeologic investigation,
2. Phase 2 groundwater sampling,
3. Explosive gas monitoring,
4. Site survey,
5. Investigation-derived waste (IDW) management, and
6. Geotechnical testing.

6.0 SITE ASSESSMENT SAMPLING AND ANALYSIS PLAN

This section describes the tasks that will be implemented as part of closure and post-closure activities fro the Parsons Landfill site. This section includes a discussion of field sampling protocols, selection of analytical parameters, and specific QA protocols. Appendix A contains standard operating procedures (SOPs) for activities described in this sampling and analysis plan. FTN will gain access to the facility as ADEQ's representative. A site-specific health and safety plan for work at the Parsons site is included in Appendix B. Table 6.1 is a summary of the samples that will be collected and analyzed.

6.1 Selection of Analytical Parameters

Parameters selected for analysis are described in this section. Laboratory analyses will adhere to methods described in Test Methods for Evaluating Solid Waste-Physical/Chemical Methods SW-846 (USEPA 1986 and online updates) (except for TDS). Table 6.1 identifies the estimated number of samples (including QC) to be collected and the proposed analytical methods to be used. An ADEQ-certified laboratory will provide analytical services. American Interplex Corporation Laboratories (AIC) will provide these services.

6.1.1 Surface Soil

Surface soils samples collected from the wastewater sludge composting area (if identified) will be submitted for analysis of Kjeldahl nitrogen, phosphorus, pH, mercury, nitrates, nitrites, ammonia, potassium, and the metals arsenic, cadmium, copper, chromium, lead, nickel, selenium, zinc, and iron.

Table 6.1. Summary of analytical methods.

Parameter Name	Analytical Method	Phase 1 – Estimated Number of Water Samples**	Phase 1 – Estimated Number of Soil Samples**
Inorganic Parameters			
Sulfate	USEPA 9056	47	10
TOC	USEPA 9060/Induction Furnace (soil)	47	10
Chloride	USEPA 9056	47	10
TDS	SM 2540C	47	n/a
Iron	USEPA 6010B/6020	94*	15
Manganese	USEPA 6010B/6020	94*	10
Antimony	USEPA 6010B/6020	47	10
Arsenic	USEPA 6010B/6020	94*	15
Barium	USEPA 6010B/6020	94*	10
Beryllium	USEPA 6010B/6020	47	10
Cadmium	USEPA 6010B/6020	94*	15
Chromium, Hexavalent	USEPA 3060A (soil)/7196A	94*	15
Chromium	USEPA 6010B/6020	94*	15
Cobalt	USEPA 6010B/6020	47	10
Copper	USEPA 6010B/6020	47	15
Lead	USEPA 6020	94*	15
Mercury	USEPA 7470A/7471A	47	15
Nickel	USEPA 6010B/6020	94*	15
Selenium	USEPA 6020	47	15
Silver	USEPA 6010B/6020	47	10
Thallium	USEPA 6010B/6020	47	10
Tin	USEPA 6010B	47	10
Vanadium	USEPA 6010B/6020	47	10
Zinc	USEPA 6010B/6020	94*	15
Cyanide	USEPA 9010B, 9014	47	10
Sulfide	USEPA 9030B	47	10
Total Kjeldahl Nitrogen	SM 4500 NH3-E	0	5
Total Phosphorus	USEPA 6010B	0	5
pH	USEPA 9045C	0	5
Nitrate + Nitrite as N	USEPA 9056	0	5
Ammonia as N	SM 4500 NH3-BE	0	5
Potassium	USEPA 6010B/6020	0	5
Calcium	USEPA 6010B/6020	30	n/a
Magnesium	USEPA 6010B/6020	30	n/a
Organic Parameters			
Appendix 2 VOCs	USEPA 5030B, 8260B	47	0
Appendix 2 SVOCs	USEPA 8270B	47	10
Appendix 2 Herbicides	USEPA 3535, 8151A	47	10
Appendix 2 Pesticides	USEPA 3510C, 8081A	47	10
PCBs	USEPA 3510C, 8082	47	10
Isobutyl Alcohol	USEPA 8015B	47	10

Notes: Soil sample metals preparation by USEPA 3051.
*Includes total and an assumed dissolved analysis.
**Includes QC samples.

6.1.2 Springs and Seeps

Spring and seep water samples will be analyzed for Regulation No. 22 Appendix 2 constituents and iron, manganese, TDS, sulfate, chloride, total organic carbon (TOC), pH, and specific conductivity (dissolved concentrations will be measured for metals with detections from total metals analysis). Calcium and magnesium will also be measured to assess hardness for comparing results to Regulation No. 2 criteria.

6.1.3 Surface Water

Surface water samples will be analyzed for Regulation No. 22 Appendix 2 constituents and iron, manganese, TDS, sulfate, chloride, TOC, pH, and specific conductivity (dissolved concentrations will be measured for metals with detections from total metals analysis). Calcium and magnesium will also be measured to assess hardness for comparing results to Regulation No. 2 criteria.

6.1.4 Sediment

Sediment samples will be analyzed for Regulation No. 22 Appendix 2 constituents (except VOCs) and iron, manganese, sulfate, chloride, and TOC.

6.1.5 Groundwater

Phase 1 groundwater samples will be submitted for laboratory analysis of Regulation No. 22 Appendix 2 constituents and iron, manganese, TDS, sulfate, chloride, TOC, pH, and specific conductivity (dissolved concentrations will be measured for metals with detections from total metals analysis). Phase 2 groundwater samples will be submitted for laboratory analysis of:

- A modified list of Appendix 2 constituents that is based on the results of Phase 1 sampling of surface water, groundwater, and leachate;
- Iron;
- Manganese;
- TDS;
- Sulfate;

- Chloride; and
- TOC.

6.1.6 Leachate

Leachate samples will be submitted for laboratory analysis of Regulation No. 22 Appendix 2 constituents and iron, manganese, TDS, sulfate, chloride, TOC, and pH (dissolved concentrations will be measured for metals with detections from total metals analysis).

6.2 Sampling Locations and Field Sampling Methodology

Fieldwork will include surface soil, surface water, sediment, groundwater, and leachate sampling as well as non-sampling activities. The performance objective is to collect representative samples for laboratory analysis. This section includes a general description of methodologies that will be followed. Appendix A contains SOPs for activities described in this sampling and analysis plan.

6.2.1 Surface Soil Sampling

An attempt will be made to identify the area used for wastewater sludge composting, reported to be north of the Class 4 area, during the site reconnaissance. If identified, FTN will collect up to three surface soil samples at the area. Grab samples will be collected from 0 to 6 inches bgs. A hand scoop or similar sampling tool will be used following procedures in SOP 310. A background sample and one QC sample (duplicate) will also be collected.

6.2.2 Spring and Seep Sampling

FTN anticipates collecting samples from the springs and seeps at the locations shown on Figure 6.1. Other sample locations may be added to the sampling list following additional reconnaissance. FTN will survey the general area shown on Figure 6.2 during the site reconnaissance to locate additional seeps/springs. At least two sampling events will be conducted during the project to establish concentrations during normal conditions and following a storm event to investigate storm event fluctuations; however, Phase 1 sampling is anticipated to include only one event. Grab samples will be collected using either a transfer device or by direct grab

following procedures in SOP 330. Sixteen seep/spring samples are anticipated to be collected along with four QC samples (two duplicates, one rinsate blank, and one trip blank).

6.2.3 Surface Water Sampling

FTN will collect surface water samples from onsite ponds, Friendship Creek Cove, and nearby ponds that are identified in the site reconnaissance. Proposed locations are shown on Figure 6.2; other sample locations may be added to the sampling list following additional reconnaissance. At least two sampling events will be conducted during the project to establish concentrations during normal conditions and following a storm event to investigate storm event fluctuations; however, Phase 1 sampling is anticipated to include only one event. Grab samples will be collected using either a transfer device or by direct grab following procedures in SOP 330. Surface water is anticipated to be collected from approximately eight locations and two QC samples (one rinsate blank and one duplicate) will be collected. These numbers may be adjusted based on findings from the site reconnaissance.

6.2.4 Sediment Sampling

Sediment samples will be collected downgradient from observed seeps or leachate areas. A few samples of the solids and precipitants will be taken at seeps or leachate areas. Anticipated locations are shown on Figure 6.2; other sample locations may be added to the sampling list following additional reconnaissance. Because these samples will not be collected from free-flowing streams, they will be treated as surface soils. Grab samples will be collected using a hand scoop or similar sampling tool, following procedures in SOP 310. Sediment samples are anticipated to be collected at approximately eight locations (including one background, identified as SO-1 on Figure 6.2) and two QC samples (one rinsate blank and one duplicate) will be collected.

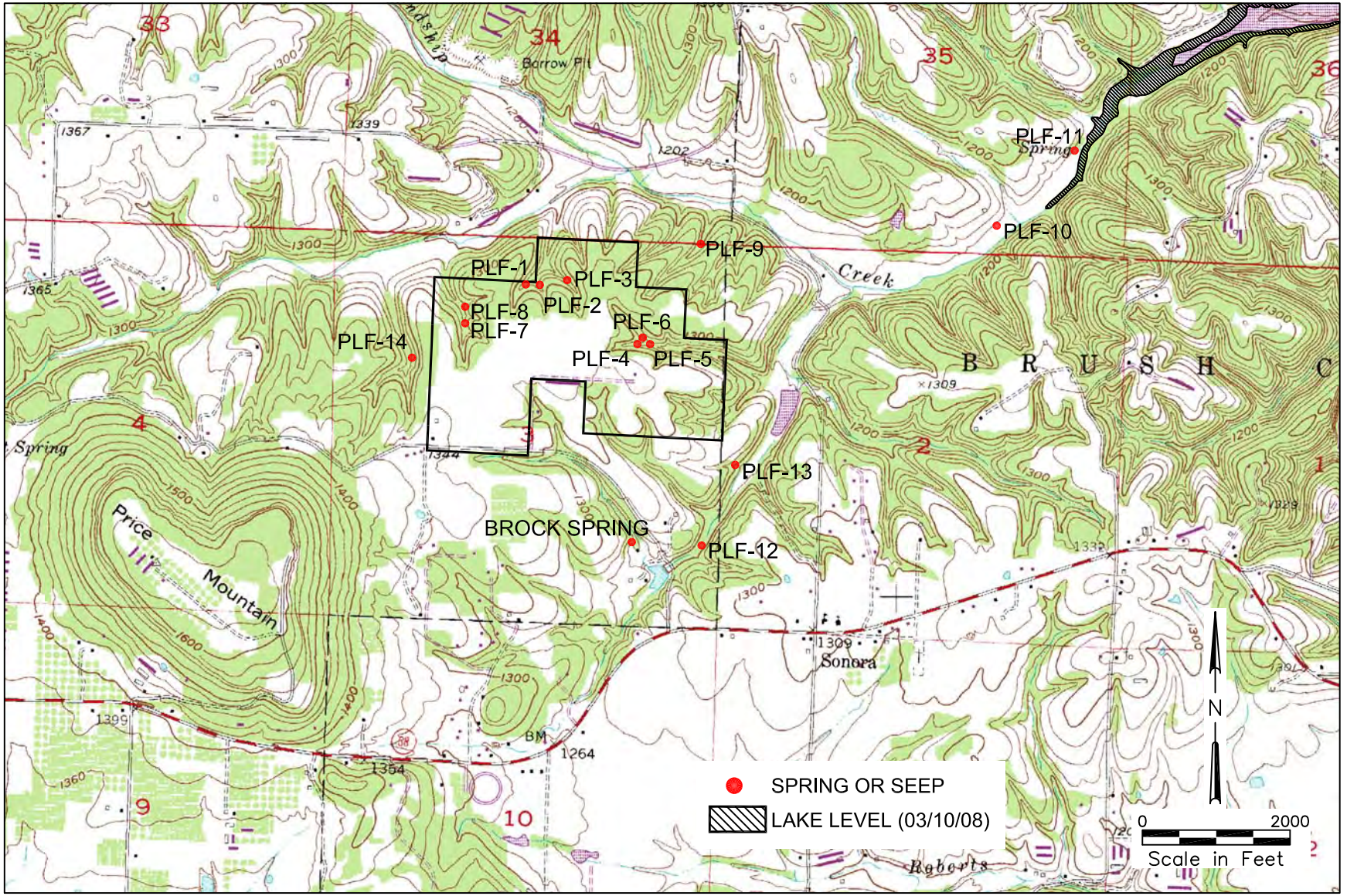

Figure 6.1. Proposed spring/seep sampling locations.

N

0 100 200 400

SCALE 1"=200'

LEGEND

- TREE LINE
- TREE/SHRUBS
- FENCE
- PAVED ROAD
- UNPAVED ROAD
- POWER POLE
- EDGE OF WATER OR DRAINAGE WAY
- BUILDING
- MW-1 EXISTING GROUNDWATER MONITORING WELL
- SD-1 PROPOSED SEDIMENT SAMPLING LOCATION
- SW-1 PROPOSED STORMWATER SAMPLING LOCATION
- L-1 PROPOSED LEACHATE SAMPLING LOCATION

NOTES:

1. THIS TOPOGRAPHIC MAPPING WAS COMPILED USING PHOTOGRAMMETRIC MEHODS BY AMI ENGINEERING, INC. FROM AERIAL PHOTOGRAPHY TAKEN FROM AN ALTITUDE OF 3960-FEET ABOVE MEAN TERRAIN ON MARCH 10, 2008.
2. THIS MAPPING WAS COMPILED FOR PRODUCTION AT A FINAL MAP SCALE OF 1 INCH = 100 FEET AND TO SHOW CONTOURS ON AN INTERVAL OF 2-FEET. THE ACCURACY THAT THIS MAPPING WAS COMPILED TO MEET IS 3.8-FEET HORIZONTAL ACCURACY AND 1.2-FEET VERTICAL ACCURACY AT 95% CONFIDENCE ON WELL-DEFINED POINTS.
3. MAPPING IN AREAS WHICH ARE OBSCURRED BY VEGETATION, SHADOWS, ETC. MAY NOT MEET THE ABOVE ACCURACY STATEMENT.
4. TOPOGRAPHIC SURVEY INFORMATION IS FROM AN AERIAL SURVEY CONDUCTED BY AMI ENGINEERING, INC. ON MARCH 10, 2008.
5. GROUND WATER MONITORING LOCATIONS ARE APPROXIMATE AND BASED ON HISTORICAL MAPS OF THE SITE.
6. PROPOSED SAMPLING LOCATIONS ARE APPROXIMATE AND MAY VERY DEPENDING ON FIELD CONDITIONS.

ESA associates, ltd.
water resources | environmental | consultants

NORTHWEST ARKANSAS WASTE MANAGEMENT, INC. SITE
ARKANSAS DEPARTMENT OF ENVIRONMENTAL QUALITY
PHASE 1 WORK PLAN - LANDFILL CLOSURE
ROGERS, ARKANSAS

FIGURE 6.2
PROPOSED SAMPLING LOCATIONS

DRAWN BY: BT	FILE NAME: FG62.DWG
APPROVED: PWC	PROJECT NO. 3013-202
SCALE: 1" = 200'	DATE: 6/10/08
SHEET NO. 1 OF 1	

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6.2.5 Groundwater Sampling

During the Phase 1 investigation, one round of groundwater samples will be collected at existing monitoring wells (shown on Figure 6.2) that are determined to have the potential to provide representative samples using low-flow purging and sampling techniques. Monitoring wells will be gauged prior to purging and sampling (SOP 610). Water level depths will be measured with an electronic water level meter from the surveyed reference point at the top of polyvinyl chloride (PVC) risers and recorded to the nearest 0.01 ft. Total well depth will be measured to the nearest 0.1 ft.

In accordance with SOP 321, if the following conditions can be met for minimizing purge volume, the intake hose or pump will be positioned at the midpoint of the screened or open-hole interval:

- The same pump will be used for both purging and sampling;
- The well screen or open-hole interval is less than or equal to 10 ft; and
- The well screen is fully submerged.

If the well screen is partially submerged, and the pump will be used for both purging and sampling, the pump will be positioned midway between the measured water level and the bottom of the screen. If the screen or open-hole interval is greater than 10 ft in one or more monitoring wells, groundwater samples will be collected from two or more depth intervals in at least one well to investigate the potential for stratification of contaminants.

Monitoring wells will be purged with a peristaltic pump, submersible pump, or bladder pump at low-flow rates of approximately 0.1 to 0.5 L/min (SOP 321). Water levels will be monitored while pumping as a guide to flow rate adjustment. The goal is minimal drawdown (<0.3 ft) during purging. Under no circumstances will a well be pumped dry. The discharge rate will be measured with a graduated cylinder and stopwatch. Water levels and pumping rates will be measured and recorded every 3 to 5 minutes during purging.

Groundwater samples will be collected from the discharge line after field parameters stabilize and placed directly into sample containers. Samples will be collected at low-flow rates of less than 100 mL/min. Data stabilization is defined as three successive readings with variation

of ±0.1 su for pH, ±3% µS/cm for specific conductivity, and dissolved oxygen (DO) ±0.3 mg/L (SOP 322). Turbidity should be <10 Nephelometric turbidity units (NTUs) if possible. Instruments that will be used to collect field measurements include a LaMotte 2020 Turbidimeter and a HydroLab MiniSonde or Datasonde 4A with a flow-through cell. All measurements will be documented on the Groundwater Sampling Record in the field logbook. It is anticipated that nine groundwater samples will be collected and approximately three QC samples (one duplicate, one rinsate blank, and one trip blank) will be collected during the Phase 1 sampling event. Purge water will be contained.

During the Phase 2 investigation, a second round of groundwater samples will be collected at existing monitoring wells (that are determined to have the potential to provide representative samples) and new monitoring wells in accordance with the methodology described above.

6.2.6 Leachate Sampling

One round of leachate samples will be collected from selected existing leachate wells (that were observed during the April 2007 site visit) in the Phase 1 or Phase 2 areas of the existing landfill (Figure 6.2) that are capable of yielding a sample. To date, leachate well locations have not been established by using a GPS or any other means. Grab samples will be collected using a disposable bailer or similar sampling tool, following the general procedures in SOP 330. It is anticipated that leachate samples will be collected at approximately three locations and two QC samples (one duplicate and one rinsate blank) will be collected.

6.3 IDW

IDW will consist of both aqueous and solid wastes. IDW such as soil/rock cuttings, decontamination liquids, groundwater well purge and development liquids, disposable sampling equipment, and disposable personal protective equipment (PPE) will be segregated, placed in closed containers, and staged at a designated location on site for characterization and subsequent disposal, as described in SOP 140. All IDW containers will be labeled to indicate the type of

material contained, including depths for soils/rock, boring numbers, well identifications, and dates when materials were initially placed in the container.

Composite samples will be collected from the non-aqueous IDW containers for analytical testing and waste profile development. One composite sample will be collected for every five drums of IDW containing soil or rock cuttings. Soil/rock samples will be analyzed for VOCs, semi-volatile organic compounds (SVOCs), and RCRA metals. The "total" values for the soil samples (assuming they are greater than 0.5% solids) will be divided by 20 for comparisons with Toxicity Characteristic Leaching Procedure (TCLP) regulatory levels (see USEPA TCLP Test Method No. SW846 1311 and Title 40 Code of Federal Regulations (CFR) Part 261.24, Table 1). A factor of 20 is used to account for the dilution that occurs in the TCLP test. The disposition of aqueous IDW will be based on results of groundwater analysis.

Groundwater and soil/rock data that are below TCLP regulatory levels, thus indicative of non-hazardous wastes, will then be compared to Region 6 residential HHMSSLs. Aqueous and solid wastes having concentrations below these screening levels will be considered non-contaminated IDW and discharged to the ground. Soil samples having total concentrations that exceed TCLP levels will be further evaluated using the TCLP for VOCs and RCRA metals.

Based upon waste characterization results, the wastes will be disposed of at an appropriate disposal facility. Should the wastes be determined to be hazardous, FTN will assist ADEQ in obtaining a provisional USEPA generator identification number for the site. A responsible individual will be assigned for signing all waste manifests, if necessary, for wastes shipped from the site.

6.4 Decontamination Procedures

Disposable sampling tools (plastic or metal) will be used as much as possible to minimize the need for decontamination of sampling tools. Disposable equipment and clothing will be containerized for future disposal. All non-dedicated sampling and measurement equipment will be decontaminated. Sampling equipment will be decontaminated before each use and at the end of the day. At no time will decontaminated equipment be placed directly on the ground. General decontamination procedures are described in SOP 130.

6.5 Sample Transport and Chain-of-Custody (COC)

The laboratory will provide FTN with clean sample containers. Table 6.2 shows the type of sample containers required, volume of sample to be collected, preservatives to be used, and holding time for samples. Sample handling, packaging, and shipment and COC procedures are described in SOP 110 and SOP 120. A COC seal will be placed at the front left and rear right sides of the cooler so that anyone opening the lid will break the COC seals. Samples will be delivered either directly to the laboratory or by overnight courier to ensure timely receipt of samples. Sample custody procedures will be observed to ensure that samples are collected, transferred, stored, analyzed, and destroyed only by authorized personnel.

A COC is also necessary to document measures taken to prevent and/or detect tampering with the samples. The Field Sampling Team Leader and/or Field Geologist are responsible for the care and custody of each sample until they are relinquished to another authorized person or the designated laboratory.

The transfer of samples to other personnel will be documented on a COC record sheet. This record must include the collectors' signatures, identification of all samples collected, and date and time of collection. The individuals relinquishing and receiving samples will sign, date, and note the time on the record. The laboratory will, upon receipt of the samples, initiate internal COC records to accompany the samples through sample storage, preparation, analysis, and disposal. The laboratory will return the original completed form to FTN as part of the analytical report. The COC record will accompany the containers through all transfers in the field, during transport, and in the laboratory. A minimum of one COC record must accompany each cooler.

6.6 Non-Sampling Activities

6.6.1 File Review and Data Compilation

The site history described herein will be supplemented by investigating the history of onsite ponds permitted by the ADEQ Water Division and the water permit modifications to allow for wastewater sludge composting. The operational/trench construction history of the site will

also be reviewed along with Arkansas Highway and Transportation Department photos taken before, during, and after site operations.

Table 6.2. Sample containers, preservation, and holding times.

Analytical Parameters	Sample Volume, Container Type	Preservative, Cool, 4ºC	Holding Time
Water Matrix			
Metals	1,000 mL, plastic	HNO_3, pH <2	6 months
Hexavalent Chromium	400 mL, plastic	None	24 hours
Mercury	400 mL, plastic	HNO_3, pH <2	28 days
TOC	100 mL, plastic	H_2SO_4, pH <2	28 days
Chloride, Sulfate	100 mL, plastic	None	28 days
TDS	1,000 mL, plastic	None	7 days
VOCs	80 mL, glass	HCl, pH <2	14 days
SVOCs	1,000 mL, glass	None	7/40 days *
Cyanide	500 mL, plastic	NaOH, pH >12	14 days
Pesticides, Herbicides, PCBs	1,000 mL, glass	None	7/40 days *
Sulfide	500 mL, plastic	Zinc Acetate, NaOH, pH >9	7 days
Isobutyl Alcohol	500 mL, plastic	None	14 days
Soil Matrix			
pH	250 mL, glass	None	As soon as possible
Total Kjeldahl Nitrogen	250 mL, glass	None	Not defined
Nitrate + Nitrite as Nitrogen	250 mL, glass	None	48 hours
Ammonia as Nitrogen	250 mL, glass	None	Not defined
Total Phosphorus	250 mL, glass	None	6 months
Total Metals	250 mL, glass	None	6 months
Hexavalent Chromium	250 mL, glass	None	24 hours
Mercury	250 mL, glass	None	28 days
TOC	250 mL, glass	None	28 days
Chloride, Sulfate	250 mL, glass	None	28 days
SVOCs	250 mL, glass	None	7/40 days *
Cyanide	250 mL, glass	None	14 days
PCBs	250 mL, glass	None	7/40 days *
Pesticides, Herbicides	250 mL, glass	None	7/40 days *
Sulfide	250 mL, glass	None	7 days
Isobutyl Alcohol	250 mL, glass	None	14 days

*Time between sample collection and extraction/time between extraction and analysis

FTN will compile, review, and summarize available information related to the project site. This will include compiling a database of existing data, reviewing the database, and qualifying data of questionable quality. A water well search for wells within 2 miles of the site will be conducted using available records at the Arkansas Geological Commission, USGS, and

the Arkansas Department of Health. Information/data gaps will be identified and obtained where available.

6.6.2 Site Reconnaissance

A site reconnaissance will be conducted to:

1. Verify the locations/construction conditions of existing groundwater monitoring wells, gas vents, and leachate wells. Establish coordinates using GPS techniques during period of minimal overhead tree canopy. The surface condition will be examined and total depths and water levels will be measured at each location. Explosive gas will also be measured at each location. Approximate casing stick-up will be measured at each monitoring well.
2. Attempt to locate original groundwater wells at the site that were reportedly replaced to verify that they were plugged and abandoned.
3. Remove the PVC, QED diaphragm-type pumps from MW-1, MW-12, and MW-13, if possible, to assess their condition.
4. Locate seeps and springs and establish coordinates using GPS techniques (during wet period of year with minimal overhead tree canopy). Label/stake seeps near the landfill to allow for consistent identification by future sampling entities.
5. Identify and delineate areas used for Class 1 waste disposal, Class 4 waste disposal, and sludge composting; determine if proposed expansions to each landfill were implemented. This will include delineating areas where the landfill cover is cracked and areas of differential settlement. Establish limits of each area using GPS techniques.
6. Locate and identify stormwater outfalls.

6.6.3 Aerial Survey

FTN will subcontract conducting an aerial topographic survey of the site that will be used in the assessment of current conditions and in conjunction with the design of any future remedial measures. The aerial survey will be conducted by AMI Engineering, Inc. of Little Rock, Arkansas.

6.6.4 Pump Removal

FTN will remove pumps from the existing monitoring wells and stage them at an appropriate location on site.

6.6.5 Monitoring Well Installation

FTN will evaluate the need for additional groundwater monitoring wells at the site after information from the site reconnaissance and Phase 1 sampling is evaluated. To install additional monitoring wells, FTN will subcontract the services of an Arkansas-licensed driller for drilling and soil/rock sampling. Drilling, well construction, and well development procedures are described in SOPs 410, 510, and 511, respectively. Borehole soils will be continuously logged from ground surface to the bedrock surface in accordance with American Society of Testing and Materials (ASTM) Standard D 2488-93 and USCS. Monitoring well locations will be selected to assess contaminant migration pathways in the aquifer and to assess the potential for offsite impacts to groundwater. Borehole information will be used to supplement existing site data and to allow for construction of more detailed geologic cross-sections for the site. Proposed well locations and installation/construction details will be provided in the Phase 2 Work Plan.

Existing monitoring wells that are unusable or deemed incapable of yielding representative groundwater samples will be decommissioned.

6.6.6 Explosive Gas Monitoring

During the Phase 2 investigation, semi-permanent explosive gas monitoring probes will be installed at the property boundary and/or other select locations, and gas monitoring will be performed. The exact number and location of probes will be based on findings from the site reconnaissance.

Depending on the local surface geology, the gas probes will be installed using either a truck-mounted drill rig using hollow-stem auger or a direct push technology (DPT) unit, using the procedures described in SOP 410. The probes will be installed to a total depth of approximately 20 ft bgs or until probe refusal. A slotted 1-inch diameter PVC pipe will be placed in the boring and the annulus space will be backfilled with sand to within 1 ft of the ground surface. The final 1 ft of annulus space will be sealed using hydrated bentonite chips. A locking cover will be installed on each probe to deter tampering or unauthorized access to the probes. Upon completion of the installation of the monitoring probes, each probe will be numbered, their

approximate location marked with a portable GPS receiver, and allowed to stabilize for a minimum of one hour. After stabilization, each probe will be monitored utilizing a LANDTEC GEM 2000 portable gas analyzer and the air will be analyzed for percent methane, percent carbon dioxide, percent lower explosive limit (LEL) for methane, and percent oxygen content. Data on the date, time, and specific location of the monitoring will be recorded. Because atmospheric pressure and local weather can impact LFG migration, the atmospheric pressure and weather conditions encountered during monitoring will also be recorded.

Three follow-up monitoring events will be conducted at approximately 30-day intervals after installation. Data from all monitoring events will be tabulated to assess if trends in the presence of LFG can be determined. If LFG is determined to be migrating offsite, additional sampling and analysis may be conducted to determine the overall impact of gas migration.

6.6.7 Site Survey

At the completion of the site investigation, locations of onsite seeps, surface soil samples, and boring/monitoring wells will be surveyed and a boundary survey will be conducted. Horizontal coordinates will be surveyed relative to the Arkansas State Plane Coordinate System and vertical coordinates will be surveyed relative to the National Geodetic Vertical Datum (NGVD) of 1929 or North American Vertical Datum (NAVD) of 1988. Reference point elevations/ground surface will be measured to the nearest 0.01 ft.

6.6.8 Geotechnical Testing

A geotechnical field and laboratory investigation will be performed to evaluate the onsite soils for use in any modifications to the landfill facility and stormwater control devices. Test pits and possibly shallow borings will be advanced in the upper 10 to 20 ft bgs to evaluate the soil profile around the existing waste areas and undisturbed areas on the Parsons property. The soils will be logged in the field using the USCS and will be collected using ASTM standards (ASTM D 2488). The samples will be submitted to a geotechnical testing laboratory for analysis of physical characteristics including:

1. Natural moisture content (ASTM D 2216),

2. Atterberg Limits (ASTM D 4318),
3. Grain size distribution (ASTM D 421 and ASTM D 1140),
4. Standard Proctor (ASTM D 698), and
5. Remolded Permeability (ASTM D 5084).

7.0 QUALITY ASSURANCE PROJECT PLAN

This section of the Phase 1 Work Plan has been prepared to serve as the Quality Assurance Project Plan (QAPP).

7.1 Project Management

The following sections address project management, documenting that the project has a defined goal, that the participants understand the goal and the approach to the be used, and the planning outputs.

7.1.1 Title and Approvals

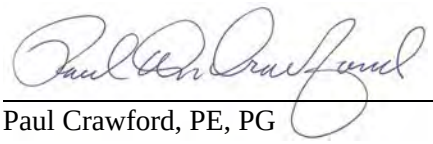
Title: Quality Assurance Project Plan for Phase 1 Work Plan, Landfill Closure and Post-Closure Activities at the Northwest Arkansas Waste Management, Inc. ("Parsons") Class 1 Landfill.

This quality assurance project plan (QAPP) has been prepared according to:

EPA Requirements for Quality Assurance Project Plans, (USEPA QA/R-5, USEPA/240/B-01/003, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, DC, March 2001).

This document will be used to ensure that environmental and related data collected, compiled, and/or generated for this project are of the type, quantity, and quality required for their intended purpose.

Approvals:



August 1, 2008
Date

Paul Crawford, PE, PG
Project Manager
FTN Associates, Ltd.

August 1, 2008
Date

Dianne Lincicome, PE, PG
Quality Assurance Coordinator
FTN Associates, Ltd.

John Overbey — Date
Laboratory Project Manager
American Interplex Corporation

Karen White — Date
Laboratory Quality Assurance Officer
American Interplex Corporation

Curtis Nunn, PG — August 1, 2008 Date
Field Sampling Leader
FTN Associates, Ltd.

Alan Nye, PhD — Date
Risk Evaluation Project Manager
CTEH

Bryan Leamons, PE — Date
ADEQ Project Manager
ADEQ Solid Waste Management Division

7.1.2 Table of Contents

The table of contents for the QAPP is provided on pages ii and iii of this Phase 1 Work Plan.

7.1.3 Distribution List

This document will be distributed to the following ADEQ, FTN, CTEH, and AIC staff involved in this project (Table 7.1).

Table 7.1. Distribution list for the QAPP.

Individual	Phone Number	Mailing Address
Bryan Leamons, PE ADEQ Project Manager	501-682-0601	ADEQ 5301 Northshore Drive North Little Rock, AR 72118-5317
Paul Crawford, PE, PG FTN Project Manager	501-225-7779	FTN Associates, Ltd. 3 Innwood Circle, Suite 220 Little Rock, AR 72211
Alan Nye, PhD Risk Evaluation Project Manager CTEH	501-801-8540	CTEH 5120 Northshore Drive North Little Rock, AR 72118
Dianne Lincicome, PE, PG FTN QA Coordinator	501-225-7779	FTN Associates, Ltd. 3 Innwood Circle, Suite 220 Little Rock, AR 72211
Curtis Nunn, PG FTN Field Sampling Leader	479-571-3334	FTN Associates, Ltd. 124 W. Sunbridge, Suite 3 Fayetteville, AR 72703
John Overbey Laboratory Project Manager AIC	501-224-5060	AIC 8600 Kanis Road Little Rock, AR 72204
Karen White Laboratory QA Officer AIC	501-224-5060	AIC 8600 Kanis Road Little Rock, AR 72204

Additional distribution to staff involved in this project will be conducted as necessary.

7.1.4 Project/Task Organization

7.1.4.1 Purpose/Background

The purpose of the project organization is to provide involved parties with a clear understanding of the role that each plays in the project and to provide lines of authority and reporting for the project.

7.1.4.2 Roles and Responsibilities

This section describes the overall organization of the monitoring and evaluation that will be conducted by FTN under contract with ADEQ. The project management, quality program, and water quality sampling activities are included in this QAPP. Duties and responsibilities of personnel for various aspects of the sampling, analysis, and reporting process are described along with an implementation schedule.

Laboratory testing and QA/QC activities will be coordinated and managed according to SOPs and the internal QA/QC plan currently in place at AIC. A copy of the AIC QA/QC Manual (AIC 2007) is available in its entirety upon request. Applicable portions are included in Appendix D. AIC will perform all analytical services.

The organizational aspects of a program provide the framework for conducting tasks. The organizational structure and function can also facilitate project performance and adherence to QC procedures and QA requirements. Key project roles are filled by those persons responsible for ensuring the collection of valid data and the routine assessment of the data for precision and accuracy, as well as the data users and the persons responsible for approving and accepting final products and deliverables. The program organizational chart is presented on Figure 7.1 and includes relationships and lines of communication among all participants and data users. The responsibilities of these persons are described in Table 7.2.

7.1.5 Problem Definition/Background

This project will provide data in support of assessing the need for post-closure corrective action at the Parsons Landfill. The objectives of the project are identified in Section 1.0 of this Phase 1 Work Plan. Data quality needs are for identification of presence or absence of site contaminants, determination of constituent concentrations, and comparison of constituents to background values and/or Region 6 residential HHMSSLs.

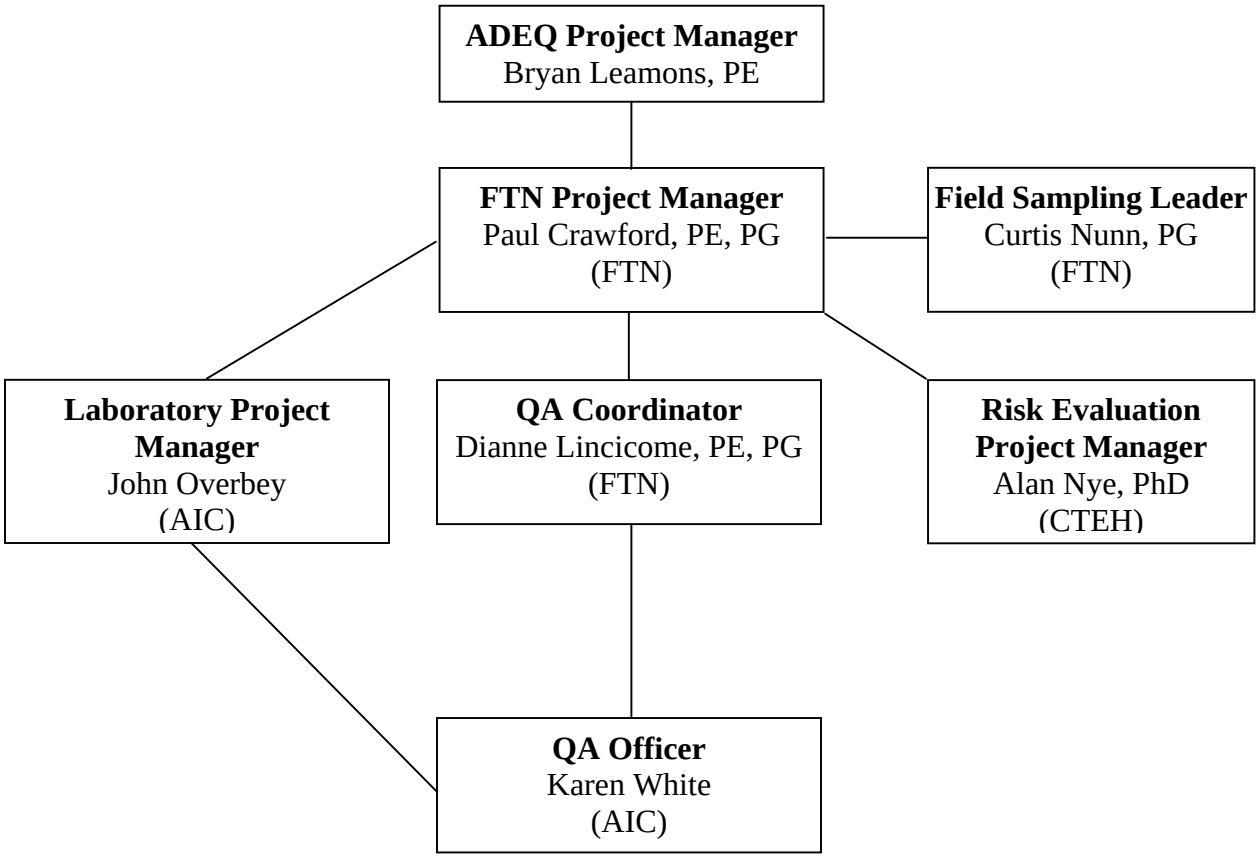


Figure 7.1. Project organization.

Table 7.2. Key positions and areas of responsibilities.

Title	Description of Duties/Responsibilities
ADEQ Project Manager	Establishes the requirements for technical work for the project and reviews project deliverables to ensure standards have been met.
FTN Project Manager	Supervises the assigned project personnel (scientists, technicians, and support staff) in providing for their efficient utilization by directing their efforts directly or indirectly on projects.
Risk Evaluation Project Manager	Supervises the preparation of the screening risk assessment, comparing site results to applicable screening levels.
FTN Field Sampling Leader	Directly supervises all field activities and is responsible for ensuring that field activities are carried out and documented in a manner that is consistent with the procedures and quality requirements specified in the QAPP.
Laboratory Project Manager	Ensures that samples are analyzed for requested parameters, provides point of contact for analytical issues, submits laboratory reports.
Laboratory QA Officer	Oversees laboratory QA/QC program, provides point of contact for QA/QC issues, reviews QA/QC results for completeness and attainment of data quality objectives.
FTN QA Coordinator	Trains field personnel, if necessary. After the field study, the FTN QA Coordinator reviews field data sheets, calibration records, laboratory reports, and other documentation to see if quality criteria specified in the QAPP were achieved.

7.1.6 Project/Task Description

Section 6.0 of this Phase 1 Work Plan describes the tasks that will be performed; Sections 8.0 and 9.0 describe the products that will be produced; and Section 10.0 presents the project schedule.

7.1.7 Quality Objectives and Criteria

No data greater than 2 years old will be used for the risk assessment. Data will initially be reviewed to determine if constituents of concern are present at the site. Data will then be compared to the appropriate screening level as discussed in Section 8.0. The goal, therefore, is to achieve detection limits that are at or below these screening levels, where USEPA SW-846 methods and quantification limits allow. The proposed methods, MCLs and Region 6 residential HHMSSLs, and laboratory practical quantitation limits (PQLs) (i.e., laboratory reporting levels) are shown in Appendix C. The laboratory can achieve the listed PQLs under optimal conditions using the analytical methods shown in the table. The laboratory's PQL may be three to ten times higher than the method detection limit (MDL) and is highly matrix-dependent, and may not be below an applicable screening level. Under less than optimal conditions, samples may contain constituents that cause or contribute to analytical interferences that can significantly affect reported detection limits. Results that are reported between the MDL and PQL will have to be qualified as "J" values. Although "J"-flagged data may not be accurate or precise, they are considered useable for screening purposes and may be carried forward to further clarify if the detected chemical is a risk driver. Typically, the maximum concentration of a chemical is used as a surrogate for long-term exposure in the risk assessment and is expected to result in a lessened chance that a chemical posing exposure of potential health concern will be removed from further consideration.

As summarized by Table 7.3, several PQLs are above applicable screening levels. These results will be addressed and discussed in the risk assessment.

Much of the historical data for the site is of questionable quality because of a lack of QA/QC documentation and undocumented sampling procedures. Therefore, existing data will be

compiled and presented in the database but will not be compared to Region 6 residential HHMSSLs.

7.1.8 Special Training/Certification

No specialized training or certification is necessary for implementation of the field work described in Section 6.0. Sampling and laboratory personnel involved with this project will be familiar with the requirements of this QAPP and are experienced or will be trained in the procedures necessary for sampling and analysis.

In the event that results suggest chemical analyses that are not part of ADEQ's certification process or for which AIC is not ADEQ-certified, the FTN Project Manager will coordinate with ADEQ staff to identify the appropriate analytical support and/or approach.

7.1.9 Documents and Records

The FTN Project Manager will ensure that field personnel have been provided the most current approved version of the QAPP. The Field Sampling Team Leader is responsible for monitoring sampling operations and ensuring that pertinent information is recorded during sampling operations. Site-dedicated notebooks will be used for recording field observations and measurements, and entries will be made in black, indelible ink. These logs will be archived as permanent records. Any deviation from the Work Plan during a sampling event and the reasons for the deviation will be documented. Information that is recorded during field activities and sampling events is described in SOP 120.

Documents that will be produced are described in Section 9.0. The laboratory data-report package will include a written and electronic submission according to routine practices employed by the laboratory. The narrative description will include a description of any QC issues encountered and corrective action taken.

Original copies of laboratory testing records (data sheets, COCs) will be stored and maintained at AIC. Copies of project records including documentation of email and telephone communication among project team members will be maintained at FTN Associates, Ltd. (3 Innwood Circle, Suite 220, Little Rock, AR 72211).

Table 7.3. List of constituents with reporting levels exceeding screening levels.

Constituent	Water			Soil
	Reporting Level Exceeds MCL	Reporting Level Exceeds Residential Water HHMSSL	Reporting Level Exceeds Regulation No. 2 Acute Criteria	Reporting Level Exceeds One or More Soil HHMSSL
Benzo(a)anthracene		X		X
Benzo(a)pyrene	X	X		X
Benzo(b)fluoranthene		X		X
Benzo(k)fluoranthene		X		
Bis(2-chloroethyl)ether (or Dichloroethyl ether)		X		X
Chlorobenzilate		X		
Dibenz[ah]anthracene		X		X
3,3-Dichlorobenzidine		X		
3,3'-Dimethylbenzidine		X		X
Dinoseb	X	X		
Disulfoton		X		
Hexachlorobenzene				X
Hexachlorobutadiene		X		
Hexachloroethane		X		
Indeno(1,2,3-cd)pyrene		X		X
Kepone		X		X
1,3-Dinitrobenzene (or m-dinitrobenzene)		X		
Methyl parathion		X		
N-Nitrosodi-n-butylamine		X		X
N-Nitrosodiethylamine		X		X
N-Nitrosodimethylamine		X		X
N-Nitroso di-n-propylamine		X		X
N-Nitroso-N-methylethylamine		X		X
N-Nitrosopyrrolidine		X		X
Pentachloronitrobenzene		X		
Acrolein		X		
Bromodichloromethane		X		
Chloroform		X		
1,2-Dibromo-3-chloropropane		X		
Dibromochloromethane		X		
1,2-Dibromoethane		X		
1,4-Dichloro-2-butene		X		
Methacrylonitrile		X		
Aldrin		X		
HCH (alpha) (or Alpha-BHC)		X		
HCH (beta) (or Beta-BHC)		X		
HCH-technical (or Delta-BHC)		X		
Dieldrin		X		
Heptachlor		X		
Heptachlor epoxide		X		
Toxaphene			X	
PCBs		X	X	

7.2 Data Generation and Acquisition

The following sections address aspects of data generation and acquisition to ensure that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and QC objectives are employed and documented.

7.2.1 Sampling Process Design

The sampling plan for the project is included as Section 6.0 of this Phase 1 Work Plan and includes the types and numbers of samples required, design of sampling network, sampling locations and frequencies, sample matrices, and analytical parameters. The rationale for the sampling plan, as prepared, was to investigate potential pathways and to evaluate impacts to the environment from a municipal solid waste landfill.

7.2.2 Sampling Methods

Procedures and equipment for collecting samples are described in Section 6.0 and/or the SOPs included in Appendix A of this Phase 1 Work Plan. Preservation requirements, decontamination procedures, sampling methods, sample containers, sample volumes, and maximum holding times are described in Section 6.0 of this Phase 1 Work Plan. Analytical support will be provided by AIC.

During the course of the investigation, it will be the responsibility of the FTN Project Manager and sampling team members to see that sampling procedures are followed and all measurement data meet prescribed acceptance criteria. In the event a problem is discovered (e.g., equipment malfunction), prompt action will be taken to correct the problem. Actions taken will be noted in field logbooks. Samples and monitoring data that are collected and later deemed to be invalid will be identified as such and the need for resampling will be determined by ADEQ and FTN Project Managers.

7.2.3 Sample Handling and Custody

7.2.3.1 Purpose/Background

This section of the QAPP describes procedures necessary to ensure that:

- Samples are collected, transferred, stored, and analyzed by authorized personnel;
- Sample integrity is maintained during all phases of sample handling and analysis; and
- An accurate written record is maintained of sample handling and treatment from the time of its collection through laboratory procedures.

7.2.3.2 Sample Custody Procedures

Sample Log-In Documents

An example of the sample COC form that will be used for the project is provided on Figure 7.2. COC procedures are discussed in Section 6.5 of this Phase 1 Work Plan. Delivery to the laboratory will be accomplished through FTN personnel or commercial couriers. The laboratory will receive the original COC form with the samples arriving from the field crew. The laboratory will send a copy of each COC form (either a hard copy or an electronic scanned image) to the FTN Project Manager at the same time as the analytical results are reported.

Sample Numbering System

Prior to field activities, the laboratory will label sample bottles to indicate which bottles to use for different analyses. At the time of sampling, field crews will mark each sample bottle with the location identification (ID), date and time, and sampling personnel. Samples with a corresponding field duplicate will be identified by using the location ID and appending "-1" for the original sample and "-2" for the duplicate sample.

Sample Integrity

All sample containers will be preserved if necessary and placed on ice or in a refrigerator immediately upon collection. Sample integrity will be maintained by ensuring that samples remain on ice or refrigerated at all times after collection.

Date	Project Name	Project No.	Project Manager (Print)	Page ____ of ____
	Parsons Phase 1 Investigation	**3013-202**	**Paul Crawford**	

Report and Bill to:	Analytical Laboratory:	Parameters (Method Number)	Lab Turn-Around-Time
Paul Crawford FTN Associates, Ltd. 3 Innwood Circle, Suite 220 Little Rock, AR 72211 (501) 225-7779 • Fax (501) 225-6738	American Interplex Corporation Laboratories 8600 Kanis Road Little Rock, AR 72204-2322 (501) 224-5060 • Fax (501) 224-5072		☐ 24 Hours ☐ 48 Hours ☐ Normal ☐ Other: Due: ___/___/___
Sampler Signature(s)	Recorded By (Print)		

SAMPLE DESCRIPTION

Sample Identification	Date	Time	Matrix* W	Matrix* S	Matrix* O	No. of Containers	Comp	Grab							**Laboratory Notes**
						Container Type									
						Preservative									

* Matrix: W = Water S = Soil O = Other

G = Glass P= Plastic V = VOA vials H = HCl to pH2 T = Sodium Thiosulfate
NO = None S = Sulfuric acid pH2 N = Nitric acid pH2 B = NaOH to pH12 Z = Zinc acetate

Relinquished By (Signature)	Print Name	Date Time	Received By (Signature)	Print Name	Date Time
		|			|
Relinquished By (Signature)	Print Name	Date Time	Received By Laboratory (Signature)	Print Name	Date Time
		|			|

Sampler Remarks:	Laboratory Remarks:
E-mail Copy: Paul Crawford – pwc@ftn-assoc.com	

Figure 7.2. Example of sample log-in/COC form.

Sample Custodians

Sample custody in the laboratory will be supervised by the AIC Sample Custodian according to AIC's QA/QC Manual. The AIC Sample Custodian will be responsible for entry of the sample into the AIC sample log-in and analysis system.

7.2.4 Analytical Methods

Analytical methods are summarized in Table 6.1 of this Phase 1 Work Plan. Laboratory analyses will adhere to methods described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846) *(*USEPA 1986, and online updates) except for TDS analyses, which will follow USEPA's *Methods for the Chemical Analysis of Water and Wastes* (USEPA 600/4-79-020), and latest revisions. No special turnaround time has been specified for this project.

It will be the responsibility of laboratory personnel to see that all measurement data meet prescribed acceptance criteria. In the event a problem is discovered (e.g., equipment malfunction, exceedance of control limits), prompt action will be taken to correct the problem. Actions taken will be noted in laboratory logbooks. The laboratory QA officer in consultation with the project's QA Manager will initiate corrective action resulting from QA audits, if needed.

Reporting levels to be used for this project are included in Appendix C.

7.2.5 Quality Control

The purpose of this section is to describe the system of technical activities that measures the attributes and performance of process against defined standards to verify that the information generated meets stated requirements. QC samples for the field and laboratory will include duplicate samples, blanks, matrix spikes, laboratory control samples, and surrogates, as described below. QC samples will be handled in the same manner as regular samples with respect to sample handling and COC procedures.

7.2.6 Field QC Procedures

Duplicate Samples

A field duplicate will be collected and analyzed with every sample set composed of one to ten samples. A sample set is a collection of samples of the same type of media. Sample sets composed of more than ten samples will have at least 10% of the set as field duplicates. Duplicate samples will be collected from the same location and prepared in the same manner as the original sample. The analysis of the duplicate samples will provide an indication of sample variability and error. The field duplicate will also check the consistency of field sampling techniques. The goal for duplicate samples is a relative percent difference (RPD) of less than 50%.

Field Blanks

AIC will provide analyte-free water for the aqueous-matrix field blanks. This water will be from the same source as that used for method and trip blanks. Field blanks are prepared by pouring the analyte-free water through decontaminated equipment or pumps and collecting the rinsate. One rinsate blank per day per type of equipment will be collected.

Trip Blanks

Water-matrix trip blanks will be provided by the laboratory from the same source of analyte-free water as that used for method and field blanks. The trip blank must remain in the cooler at all times during sampling and sample transport to the laboratory. One trip blank will accompany each cooler containing samples for VOC analysis.

Matrix Spike/Matrix Spike Duplicates (MS/MSD)

MS/MSD will be used to measure the precision and accuracy of the laboratory's analytical equipment. A sufficient volume will be collected and sent to the laboratory for analysis such that an MS/MSD sample can be analyzed for every 20 media samples.

7.2.6.1 Laboratory QA/QC Procedures

The contract laboratory will follow its own internal QA/QC procedures for method blanks, duplicates, and laboratory control samples (LCSs). The laboratory maintains written documentation of these QA/QC procedures. Applicable portions of the laboratory QA/QC Manual for AIC are provided in Appendix D.

Precision of laboratory analyses will be measured using analytical duplicate results. The RPD for two concentrations (C_1 and C_2) will be calculated as:

$$RPD = \frac{abs\ (C_1 - C_2)}{(C_1 + C_2) / 2} \times 100\%$$

Accuracy of laboratory analyses is evaluated by the comparison of the percent recovery of the spiked sample analysis and/or LCS of known concentrations to control limits. Control limits have been established for each method of analysis (see Appendix D).

Completeness (%C) of the analytical effort can be calculated as follows:

$$\%C = (V/T)\ X\ 100$$

where:
%C = completeness of the analytical effort
V = number of valid samples analyzed
T = number of samples received

Corrective Action

AIC will provide QA documentation according to their QA/QC Manual. When laboratory data sets do not meet data quality objectives (Section 7.1.7), laboratory personnel will upon consultation with FTN and ADEQ Project Managers determine the need for reanalysis.

7.2.7 Instrument / Equipment Testing, Inspection, and Maintenance

Field instruments that will be used during the investigation include a turbidity meter, water level indicator, HydroLab MiniSonde or Datasonde sensors, and LANDTEC GEM 2000

portable gas analyzer. Proper working condition of field instruments will be verified before the field survey begins.

Instruments will be calibrated at the beginning of each measurement period. Proper working condition will be assumed if successful calibration is accomplished. Proper working condition at the end of the measurement period will be assessed by recording instrument readings in standard buffer solutions (pH) and standard solutions (conductivity) as per manufactured instructions. The LANDTEC GEM 2000 portable gas analyzer is returned to the manufacturer annually for factory calibration and certification.

Laboratory instruments used as part of analytical testing will be inspected calibrated and maintained per AIC's QA/QC Manual.

7.2.8 Instrument / Equipment Calibration and Frequency

The Field Sampling Team Leader is responsible for calibrating the instruments under his/her control per manufacturer's specifications before each use. Calibration data will be recorded along with the identity of the instrument used for analysis. Backup meters will be part of the field crew's equipment. The backup meters will be calibrated the day of sampling along with the primary meters. Instances of instrument malfunction will be minimized through careful attention to the manufacturer's specifications and recommendations regarding calibration, handling, placement, and maintenance of instruments. The calibration date, person calibrating the instrument, standards used, and problems, if any, with the calibration procedures will be entered into the field logbook each time the instrument is calibrated. Records of these calibrations will be available upon request to FTN's QA Manager as part of the QA requirements.

Field instruments will be calibrated immediately prior to each field trip, at the end of the day, and at any time a meter drift is suspected. If significant drift is detected, the data obtained during the day is flagged or deleted depending on the magnitude of the drift. Calibration criteria for field instruments follow:

1. The water level meter will be calibrated with a metal tape prior to leaving for the field (SOP 610).

2. Turbidity meter – Calibration of the turbidity meter will follow manufacturer's specifications. A 0-, 20-, and 200-NTU standard will be used for this purpose. Meter accuracy will be ± 0.5 or ± 2% below 100 NTU.
3. Calibration of the HydroLab MiniSonde or Datasonde sensors will follow SOP 322.
4. Field calibration of the LANDTEC GEM 2000 portable gas analyzer uses certified gas calibration cylinders and will conform to the procedure specified by the manufacturer. The portable analyzer is returned to the manufacturer annually for factory calibration and certification.

Calibrations requiring the use of standards (conductivity, pH) will include documentation of lot number of standard used.

7.2.9 Inspection / Acceptance of Supplies and Consumables

The Field Sampling Leader will be responsible for obtaining and inspecting materials and solutions for field measurements. Other materials must also meet specific requirements as indicated by the manufacturers. Any buffers and standards used will be checked for expiration dates and appearance (e.g., correct color). Only recently purchased standards will be used for meter calibration. Calibration standards will have been purchased within 30 days of analysis.

Inspection of laboratory supplies and consumables will be performed per AIC's QA/QC Manual.

7.2.10 Non-Direct Measurements

No non-direct measurements are anticipated as part of this Phase 1 investigation.

7.2.11 Data Management

7.2.11.1 Purpose/Background

This section presents an overview of mathematical operations and analyses performed on raw data as well as internal checks used to validate data entry.

7.2.11.2 Data Recording

After receiving QC checks described in Section 7.4.5, field data and laboratory data will be transferred to Excel spreadsheets. Where possible, laboratory data will be imported electronically without manual data entry.

7.2.11.3 Data Validation

All data entry and transcription from field, laboratory bench sheets, and laboratory reports will be verified. Data and observations entered into spreadsheets will be traceable to original data sheets through project number, date, and operator ID. Manual data entry will be verified by personnel not involved in data entry. Initials of the persons performing data entry and verification will be included in spreadsheet documentation.

Data review will be performed by the FTN QA Coordinator or her designee upon receipt of the data package from the analytical laboratory and prior to release of results. This review is done separately from the laboratory performing the analytical work and will consist of the following tasks:

1. Compile a list of all investigative and QC samples, including field blanks and trip blanks, method blanks, and MS/MSD results;
2. Review COC documents for completeness and correctness;
3. Review laboratory analytical procedures and instrument performance criteria, as appropriate for sample holding time, instrument performance, blanks, surrogate recovery, compound identification, and compound quantification;
4. Review data summaries for sample media identification, sample location and descriptions, proper concentration units, and proper significant figures; and
5. Identify potential data quality problems including unexpected results, common laboratory contaminants, and unusual spatial concentration/identification relationships.

USEPA guidance (1989) will be followed in evaluating data sets with contaminants detected in blank samples as discussed below:

- Blanks containing common laboratory contaminants. Acetone, 2-butanone (or methyl ethyl ketone), methylene chloride, toluene, and the phthalate esters are

considered by USEPA to be common laboratory contaminants. If the blank contains detectable levels of common laboratory contaminants, then the sample results will be considered as positive results only if the concentrations in the sample exceed ten times the maximum amount detected in any blank. If the concentration of a common laboratory contaminant is less than ten times the blank concentration, then it will be concluded that the chemical was not detected in the particular sample and, in accordance with USEPA guidance, the blank-related concentrations of the chemical will be considered to be the quantitation limit for the chemical in that sample. If all samples contain levels of a common laboratory contaminant that are less than ten times the level of contamination noted in the blank, then that chemical will be completely eliminated from the set of sample results (i.e., not considered a chemical of concern).

- Blanks containing chemicals that are not common laboratory contaminants. If the blank contains detectable levels of one or more organic or inorganic chemicals that are not considered by USEPA to be common laboratory contaminants, then sample results will be considered as positive only if the concentration of the chemical in the sample exceeds five times the maximum amount detected in any blank. Samples containing less than five times the amount in any blank will be treated as non-detects and the blank-related chemical concentration will be considered the quantitation limit for the chemical in that sample. If all samples contain levels of a chemical (not a common laboratory contaminant) that are less than five times the level of contamination noted in the blank, that chemical will be completely eliminated from the set of sample results (i.e., not considered a chemical of concern).

Corrective actions will be performed as needed to improve data quality and reduce uncertainty, and may eliminate the need to qualify or reject data. Corrective actions that may be implemented include retrieving missing information; resolving technical issues by requesting clarification from the sampling team; requesting reanalysis of sample(s) from the extract stored at the laboratory; requesting additional QC review by analytical laboratory (e.g., check for calculation or transcription errors); and requesting additional sample collection for site or background characterization. Corrections to laboratory reports will be made by requesting revised laboratory reports or by making handwritten corrections on the reports. Handwritten corrections will include documentation of discussions with laboratory QA/QC personnel. A single line will be drawn through errors and will be accompanied by the initials of the person making the correction along with the reason for the correction and the date the correction was made.

7.2.11.4 Data Storage and Retrieval

Raw field and laboratory data are kept in a project file that is controlled by the FTN Project Manager or his designee. All other raw computer files and spreadsheets are kept in the project directory on FTN's internal computer network. These directories are accessible by personnel assigned to work on the project.

Document Control

All pages of field notebooks or field documents will have the project number, date, and page number indicated in the upper right hand corner of the page or in spaces on the sheets provided for that purpose.

Field Observations

Field observations, including instrument calibration data, will be recorded in bound field notebooks. Photocopies of field notebook pages will be made as soon as possible after data collection and placed in a separate binder. These records will be compiled by the FTN Field Sampling Leader.

Analytical Data

Analytical data generated by the analytical laboratory will be transferred (electronically imported where possible) to an Excel spreadsheet and submitted to the FTN Project Manager. The project number and preparer's initials will be included as part of spreadsheet documentation.

7.3 Assessment and Oversight

The following sections address the aspects of assessment and oversight to ensure the effectiveness of project implementation and associated QA and QC activities.

7.3.1 Assessments and Response Actions

The purpose of this section of the QAPP is to describe internal and external checks that ensure the following:

- All elements of the QAPP are correctly implemented as prescribed.
- The quality of the data generated by implementation of the QAPP is adequate.
- Corrective actions, when needed, are implemented in a timely manner and their effectiveness is documented.

7.3.1.1 Assessment of Project Activities

No performance audits will be conducted for field or laboratory analyses. The Field Sampling Leader is responsible for ensuring that all necessary data are collected at each sampling site. The Field Sampling Leader is responsible for performing or directing corrective action on field-related activities. He will check field activities performed by FTN. The purpose of this self-assessment will be to verify that sampling protocols were followed, field duplicates were collected, analytical requirements were met, data quality objectives were met, and documentation of sample and field observations is correct.

Self-assessment will involve monitoring of the status of the project and examination of the records to ensure that QAPP requirements are being fulfilled. The Field Sampling Leader will conduct surveillance during each sampling day and at the end of each sampling day. This surveillance will include daily verification of:

1. Agreement between recorded sample location identifications and actual locations visited,
2. Complete instrument calibration records,
3. Successful instrument calibration,
4. Compliance with instrument calibration criteria,
5. Completeness of field data forms,
6. Collection of duplicate samples,
7. Sample shipment to laboratory,
8. Completed COC documents, and
9. Documentation of corrective action including follow up of corrective action and documentation of its effectiveness.

7.3.1.2 Reporting and Resolution of Issues

Findings of practices and procedures that do not conform to the QAPP will be reported by the Field Sampling Leader to the FTN QA Coordinator. These findings as well as deficiencies discovered by the FTN QA Coordinator will be reported to the FTN Project Manager as soon as they are discovered. Appropriate corrective action, including that already in place, will be discussed. Corrective action will then be initiated or modified as needed.

7.3.2 Reports to Management

All field data, field observations, and analytical data will be compiled by the FTN Field Sampling Leader or his designee and submitted to the FTN Project Manager. Results of QA/QC checks will be presented to the FTN Project Manager. The primary communication of the field data results to ADEQ will be the data summaries that are included in the reports described in Section 9.0 of this Phase 1 Work Plan. FTN's internal documentation of the data, including field sheets, laboratory sheets, and QA/QC results, will be available to ADEQ upon request.

7.4 Data Validation and Usability

7.4.1 Data Review, Verification, and Validation

7.4.1.1 Purpose/Background

The purpose of this section of the QAPP is to state the criteria for deciding the degree to which each data item has met its quality specifications as described in Section 7.2. This decision will be based on the investigator's estimate of the effect that each deviation from the QAPP will have on the usability of the associated data item, its contribution to the quality of the reduced and analyzed data, and its effect on the decision.

7.4.1.2 Sampling Design

The criterion for meeting the sampling design requirements of this QAPP is to collect the types of data at each location as specified in Section 6.0 of this Phase 1 Work Plan.

7.4.1.3 Field Data Collection Procedures

Criteria for compliance with field data collection sections of the QAPP are as follows:

1. Samples will be collected at the locations described in Section 6.0 in accordance with the appropriate SOP.
2. Duplicate samples will comprise at least 10% of the sample sets.
3. An alternate sampling station will be chosen if a sampling station description indicates a location that may be seen as inappropriate or nonrepresentative due to a local anomaly. A sample will be collected from an area unaffected by the anomaly (e.g., upstream) if possible.

7.4.1.4 Sample Handling

Criteria for compliance with sample handling sections of the QAPP are as follows:

1. Samples are shipped to the laboratory to allow adequate time for analysis within prescribed holding times.
2. Samples are identified by the same site location IDs used in Section 6.0, where applicable.
3. Sample integrity is maintained by ensuring that samples remain on ice at all times after collection as evidenced by temperature on arrival recorded by laboratory.
4. Sample COC documents are complete.
5. Samples remain in the possession of sampling personnel, laboratory personnel, or commercial carriers at all times.

7.4.1.5 Analytical Procedures

Criteria for compliance with analytical procedures specified in the QAPP are as follows:

1. Analytical methods reported in laboratory report match those specified in the QAPP and COC.
2. Samples are analyzed within the maximum allowable holding times specified in the QAPP.
3. Analytical data are internally consistent.
4. The QC summary is complete with the specified number of QC samples and QC results in compliance with data quality objectives.

7.4.1.6 Quality Control

Criteria for compliance with quality sections specified in the QAPP are as follows:

1. Instrument calibrations at the beginning and end of the measurement period are within specified limits and cross-check between different instruments used by separate field crews (if applicable) is within specified limits.
2. Laboratory analyses comply with Section 7.4.1.5.
3. Corrective action is identified, implemented, and validated when data sets do not meet data quality objectives.

7.4.1.7 Field Equipment Calibration

Criteria for compliance with field equipment calibration requirements specified in the QAPP are as follows:

1. Calibration records are documented for instruments requiring calibration.
2. Calibration method for each instrument is followed and calibration information documented.
3. Back-up meters are calibrated along with primary meters.
4. Calibrations requiring the use of standards include documentation of lot number of standard used.

7.4.1.8 Data Processing

Criteria for compliance with data processing requirements specified in the QAPP are as follows:

1. Data and observations that are entered into spreadsheets will be traceable to original data sheets through location ID, date, and time.
2. Manual data entry is verified by personnel not involved in data entry.
3. Initials of the persons performing data entry and verification are included in spreadsheet documentation.

7.4.2 Verification and Validation Methods

The FTN QA Coordinator or her designee will review the field and laboratory data and associated documentation (e.g., original field sheets, laboratory reports, calibration forms, COC

forms, etc.) to ensure compliance with the criteria in Section 7.2. Any deficiencies will be reported to the FTN Project Manager as soon as they are discovered. Appropriate corrective action, including that already in place, will be discussed. Corrective action will then be initiated or modified as needed and will be verified by the FTN QA Coordinator. The ADEQ Project Manager and the AIC QA Officer will be notified, if necessary, of any deficiency that might compromise the quality of the data.

7.4.3 Reconciliation with User Requirements

The results of the QA/QC review described in Section 7.4.5 will be reviewed by the FTN Project Manager to assess the usability of the data, in light of any QA/QC issues identified, for the intended purpose. In general, data that are collected such that verification and validation criteria are met will be deemed useable for the intended purpose. If data quality indicators do not meet the project's requirements, the data may be discarded and re-sampling may occur. The FTN Project Manager will evaluate the cause of the failure (if possible) and make the decision whether or not to discard the data and re-sample. If the failure is related to data quality or to the methods of analysis, calibration and maintenance techniques will be reassessed as identified by the appropriate laboratory and/or field personnel. If the failure is associated with the sample collection and re-sampling is needed, the samplers will be re-trained.

8.0 RISK EVALUATION

CTEH will conduct a screening risk assessment for all soil, groundwater, seep/spring, surface water, and sediment sample results. Surface soil sampling results will be compared to USEPA Region 6 HHMSSLs for residential property. In this screening assessment, the maximum detected concentration of a chemical in surface soil will be compared to the residential HHMSSL. In addition, for inorganic constituents, soil concentrations will be compared to typical background concentrations. In the absence of site-specific background results, regional background concentrations will be used from available sources. Generally, if the maximum detected concentration of a chemical in soil does not exceed the residential HHMSSL, groundwater protection soil screening level, or background, further risk evaluation is not warranted.

Concentrations of chemicals in groundwater will be compared to MCLs or USEPA Region 6 tap water screening levels. Tap water screening levels are based on ingestion of tap water and inhalation of chemicals volatilizing during residential indoor water use. Chemicals that do not exceed the MCL or the tap water screening level will not receive further consideration in the risk assessment.

Total surface water sample results will be compared to USEPA MCLs and APCEC Regulation No. 2 standards for protection of human health. Dissolved surface water sample results will be compared to the APCEC Regulation No. 2 water quality standards for surface waters for protection of aquatic organisms. For chemicals with no Regulation No. 2 standard, the dissolved surface water concentration will be compared to federal ambient water quality criteria for protection of aquatic organisms or other appropriate criteria and guidelines. Generally, if the maximum detected concentration of a chemical does not exceed the screening value, further risk evaluation is not required.

The seeps and springs samples will be compared to USEPA MCLs, Region 6 residential HHMSSLs, and APCEC Regulation No. 2 standards for human-health protection. The chemical concentrations that do not exceed the various screening levels will not be given further risk assessment.

Detected concentrations of chemicals in sediment will be compared to Region 6 residential HHMSSLs (as a human-health protective screening) and appropriate ecological sediment screening levels (such as USEPA Region 4 and/or USEPA Region 5 freshwater sediment screening levels) or other appropriate criteria (such as the National Oceanic and Atmospheric Administration's Screening Quick Reference Table). In addition, background values for sediment will be used to evaluate concentrations of inorganic chemicals in sediment. Chemicals present in sediment at background concentrations are generally not considered chemicals of potential concern.

A letter report outlining the risk screening procedure and results of the comparisons will be presented for review by ADEQ. No further risk assessment work will be performed unless authorized by ADEQ.

9.0 DATA EVALUATION AND REPORTS

9.1 Data Presentation

It is anticipated that Microsoft Excel will be used to manage data for this project because the laboratory can readily provide data in this electronic format and data can be compared to specific requirements of the QAPP during verification and data validation. Analytical data and other field monitoring data will be compiled into tables, at a minimum, with emphasis placed on data exceeding background, MCLs, or Region 6 residential HHMSSLs effective at the time of the evaluation.

Site maps will be developed that include one or more of the following, as appropriate:

1. Plan-view maps showing waste disposal areas, lineaments, seeps, springs, wells, ponds, and other site features.
2. Plan-view groundwater/surface water sample map at well/seep/spring locations along with analytical results of constituents of concern detected in concentrations greater than MCLs or Region 6 residential water HHMSSLs. Data will be presented in table form at sample locations.
3. Plan-view maps showing locations of gas monitoring probes along with monitoring results.
4. Potentiometric surface maps.
5. Contaminant plume maps for site-related constituents of concern present in groundwater at concentrations greater than MCLs.

In addition to the site maps, FTN will prepare cross-sections, as appropriate, which include:

1. Lithologic logs and screened intervals for wells;
2. Top of potentiometric surface and analytical results;
3. Top of bedrock surface;
4. Locations and depths of disposal areas, lineaments, surface water features; and
5. Interpreted extent of contamination displayed by a dashed line.

9.2 Reports

9.2.1 Phase 1 Closure and Post-Closure Work Activities Report

A short report will be prepared presenting the preliminary findings from the site reconnaissance and the Phase 1 field investigations. A work plan and budget for Phase 2 activities will be presented in the report to complete the Phase 2 field investigations.

9.2.2 Closure and Post-Closure Work Activities Summary Report

The Closure and Post-Closure Work Activities Summary Report will present the site history, a refined conceptual site model based on results from previous investigations and the results of the field investigations (Phases 1 and 2) that were performed, the results of the screening risk assessment comparisons, and recommendations for corrective/remediation measures and monitoring.

FTN proposes to submit a report to ADEQ for review. A narrative interpretation of the data will be presented in the conclusions, which will be brief yet comprehensive. Appendices will include necessary supporting documents, including field records and laboratory data reports. An Arkansas-registered Professional Geologist and Professional Engineer certification page will be placed at the front of the report. FTN will incorporate ADEQ's comments into the final report. FTN will provide a compact disc with an electronic version (portable document format – pdf) of the report.

10.0 PROJECT SCHEDULE

FTN has prepared a proposed implementation schedule for the project that is shown in Table 10.1. The schedule outlines the anticipated project tasks and the time to complete each task and also includes the required project progress reports that will be submitted every 4 weeks.

FTN will initiate fieldwork within 2 weeks of approval of this Phase 1 Work Plan. Based on previous discussions with ADEQ staff, no specific time constraints have been applied to this project.

Table 10.1. Proposed implementation schedule.

Task	Week Number																																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Negotiation of Refined SOW	▬																																			
Phase 1 Work Plan Preparation		▬																																		
ADEQ Review of Phase 1 Work Plan			▬																																	
Phase 1 Field Investigations				▬	▬	▬																														
Phase 1 Sample Analysis and Validation							▬	▬	▬																												
Phase 1 Data Review										▬	▬																										
Phase 1 Report and Phase 2 Work Plan/Budget Preparation												▬	▬	▬	▬																						
ADEQ Review of Phase 1 Report and Phase 2 Work Plan/Budget																▬	▬																				
Phase 2 Field Investigations																		▬	▬	▬	▬																
Phase 2 Sample Analysis and Validation																						▬	▬	▬													
Data Evaluation																									▬	▬										
Risk Evaluation																											▬	▬	▬	▬	▬	▬				
Closure and Post-Closure Work Activities Summary Report																											▬	▬	▬	▬	▬	▬	▬	▬	▬	▬
Progress Reports				◆				◆				◆				◆				◆				◆				◆				◆				◆

11.0 REFERENCES CITED

ADEQ. 2005a. Memorandum to Steve Martin from Gerald Delavan dated February 16, 2005. Status of Parsons Class 1 Landfill Site; Washington County, AR.

ADEQ. 2005b. Memorandum to Gerald Delavan from Bill Sadler dated October 17, 2005. Groundwater Sampling at "Parson's Landfill" (Northwest Arkansas Waste Management Class 1 Landfill).

AIC. 2007. Quality Assurance/Quality Control Manual. Revision 19, May 23, 2007. American Interplex Corporation.

Bolyard, S.E. 2007. Migration of Landfill Contaminants in a Tilted-Block Mantled Karst Setting in Northwestern Arkansas. A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Geology, University of Arkansas at Fayetteville, May 2007.

Goodman, W.M. 1985. A Hydrogeologic Evaluation of the Northwest Arkansas Waste Management Landfill, Washington County, Arkansas. A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science, University of Arkansas, January 1985.

McFarland, J.D. 1998. Stratigraphic Summary of Arkansas. *Arkansas Geological Commission Information Circular, 36*. 39 pp.

Steele, Kenneth F. 1989. Proposed Location of New and Replacement Monitoring Wells at Northwest Arkansas Waste Management Landfill, May 30, 1989.

USDA. 1969. Soil Survey, Washington County, Arkansas. United States Department of Agriculture, Soil Conservation Service. March 1969.

USEPA. 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (SW-846). Interim Final. United States Environmental Protection Agency. December 1989.

USEPA. 2001. USEPA requirements for Quality Assurance Project Plans (USEPA QA/R5, USEPA/240/B-01/003) United States Environmental Protection Agency, Office of Environmental Information. Washington, DC. March 2001.

USEPA. 2007. 2008 Region 6 Human Health Medium-Specific Screening Levels. United States Environmental Protection Agency. December 2007.

APPENDIX A

Standard Operating Procedures

STANDARD OPERATING PROCEDURES
CLOSURE AND POST-CLOSURE ACTIVITIES
PHASE I INVESTIGATION
PARSON'S LANDFILL
PERMIT NO. 0205-SR-2, AFIN: 72-00171

APRIL 1, 2008

STANDARD OPERATING PROCEDURES
CLOSURE AND POST-CLOSURE ACTIVITIES
PHASE I INVESTIGATION
PARSON'S LANDFILL
PERMIT NO. 0205-SR-2, AFIN: 72-00171

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April 1, 2008

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1.0 PURPOSE

This Standard Operating Procedure (SOP) states the responsibilities and describes the instructions regarding activities conducted before, during, and after field investigations.

2.0 SCOPE

2.1 This SOP shall be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.2 This SOP contains general details about procedures and equipment, which apply to most types of environmental investigations and will be reviewed prior to commencing field activities. These general instructions are intended to supplement the information contained in subsequent SOPs and clarify the role of field personnel during most types of environmental investigations.

2.3 A work plan and/or sampling and analysis plan shall be prepared, approved, and implemented for each investigation.

3.0 EQUIPMENT AND MATERIALS

The responsible Project Manager shall ensure field team members use the equipment listed in the appropriate SOP, as necessary, for the type of sampling to be conducted.

4.0 PROCEDURE

4.1 Perform Pre-mobilization Activities. The responsible Field Team Leader (FTL) shall ensure implementation of the following:

4.1.1 Determine the number of people that will be required to complete the sampling activities within the allotted time frame. For safety and efficiency, a field team should consist of at least two people.

4.1.2 Prior to conducting field activities, review applicable SOPs and associated documents (i.e., project work plan, sampling and analysis plan, quality assurance project plan, and the site-specific HASP). One copy of each document is maintained onsite and available to all field team members.

4.1.3 Review the project files for unusual procedures or site peculiarities including activities not covered by an SOP.

4.1.4 Assemble any needed maps, directions, and site descriptions.

4.1.5 Obtain utility clearance, access agreements, keys, etc.

4.1.6 Contact appropriate facility personnel prior to starting work at the site.

4.1.7 Submit an analytical request form to the laboratory and contact the laboratory before sampling begins to ensure personnel are aware of specific requirements and expected sample delivery dates.

4.1.8 Identify sample shipment carrier. Avoid sample deliveries to the laboratory on weekends and holidays.

4.1.9 Obtain and test all equipment and field instruments needed for the task. Inspect, and repair and replace as necessary. Calibrate as required by the manufacturer's instructions.

4.1.10 Assemble sample containers, field decontamination equipment, shipping supplies, and any needed safety equipment.

4.1.11 Obtain a field logbook, data collection forms, indelible/water proof pens, clipboards, cameras, etc.

4.2 Field Activities — The responsible FTL shall ensure implementation of the following:

4.2.1 Conduct a daily tailgate briefing, during which the HASP is reviewed and/or activities for that day are discussed with all project field participants, including subcontractors.

4.2.2 Observe subcontractors to ensure that all of their activities comply with the work plan, SOPs, and all applicable permits and licenses, and health and safety requirements. If health and safety problems occur, the FTL shall stop work and immediately notify the site health and safety officer or appropriate level of management.

4.2.3 Monitor and provide technical direction for the fieldwork, log samples, and take measurements.

4.2.4 Handle, package, and transport samples in accordance with SOP 110, *Sample Handling, Packaging, and Shipment*.

4.2.5 Maintain chain-of-custody integrity of all samples according to SOP 120, *Sample Control and Field Documentation*.

4.2.6 Maintain daily logbook to record information concerning equipment, personnel, site visitors, activities, weather conditions affecting the activities, and deviations from procedural requirements according to SOP 120, *Sample Control and Field Documentation*.

4.2.7 Supervise decontamination of equipment and personnel and record procedures used for decontamination in the logbook (SOP 120) according to SOP 130, *Decontamination of Drilling and Sampling Equipment*.

4.2.8 Manage waste generated during the field effort in accordance with SOP 140, *Management of Investigation-Derived Wastes*.

4.3 Prior to leaving the site, the FTL will implement the following procedures:

4.3.1 Mark sampling locations or surveying points with wooden stakes, pin flags, survey flags, or spray paint.

4.3.2 Mark containers used to store investigation-derived waste in accordance with SOP 140, *Management of Investigation-Derived Wastes*.

4.3.3 Restore the site, as reasonable, to pre-sampling conditions (e.g. repair fences, tire ruts, etc.).

4.3.4 The Project Manager shall ensure that all sampling locations are surveyed, as applicable in accordance with SOP 210, *Location Surveys*.

4.4 Upon completion of planned field activities and demobilization activities, the following procedures will be implemented:

4.4.1 The FTL shall follow up on the status of the IDW until this waste has been appropriately disposed, if applicable.

4.4.2 The FTL will ensure that all equipment has been removed from the site and is decontaminated.

4.4.3 The FTL shall prepare report quality logs and maintain these and all field records in the project files.

1.0 PURPOSE

This Standard Operating Procedure (SOP) directs field team members in the preparation of environmental and waste characterization samples for shipment to the analytical laboratory. If samples are known to be DOT regulated, the field team member who will package and ship the samples must have appropriate DOT training.

2.0 SCOPE

2.1 This SOP shall be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.2 Samples are expected to have a low concentration of potential contaminants, although higher concentrations will be present in some cases. These low-concentration samples that do not satisfy DOT hazard-class definitions are classified as environmental samples and are not subject to DOT regulations. Historical data, knowledge-of-process, and field screening results will assist the team members in making decisions as to whether a sample can be designated as "environmental" or needs to be treated as a DOT-regulated material.

2.3 While transporting samples, sample integrity (samples must be locked and/or under constant supervision and protected from tampering) and chain-of-custody must be maintained according to SOP 120, *Sample control and Field Documentation*.

2.4 Upon receipt at the analytical laboratory, a sample custodian will check each sample for proper container, preservatives, and labels and verify that the information is accurately reflected on the chain-of-custody.

2.5 The responsible Field Team Leader (FTL) will ensure the procedures in the SOP are followed.

3.0 EQUIPMENT AND MATERIALS

1. Clear tape;
2. Indelible and writing pens (black);
3. Bubble wrap;
4. Paper towels;
5. Duct tape;
6. Absorbent material;
7. Rigid plastic coolers;
8. Strapping tape;
9. Address labels;
10. Clear plastic bags (zip-lock);
11. Thermometer; and
12. Ice.

4.0 PROCEDURES FOR SAMPLE PACKAGING AND STORAGE

4.1 Check to see that sample container lids are securely closed, and wipe container exteriors with a paper towel dampened with clean water. To prevent leakage from the cooler, seal cooler drain on the inside with duct tape.

4.2 Ensure that each container has a properly completed label. Place clear plastic tape over sample labels then place sample containers in clear plastic bags. Samples that are suspected of having moderate to high concentration levels should be double bagged.

4.3 Wrap individual sample containers liberally with bubble wrap and secure the wrap with duct tape to minimize potential for breakage during shipment. For additional protection, line sides and bottom of cooler liberally with bubble wrap and pack cooler tightly before adding coolant.

4.4 Sample containers are then placed upright in a cooler. Place plastic bags of ice or other suitable coolant among the sample containers to maintain the samples at or below 4° C during transport. The presence of ice, or frozen blue ice, in an amount approximately equal to the volume of samples is sufficient indication that the samples are adequately cooled.

4.5 Water samples must not be frozen or transported with dry ice as this increases the possibility for container breakage.

4.6 If the FTL deems it necessary for liquid samples, sufficient absorbent material can be placed in the cooler to absorb liquid in the event of a sample container breakage.

4.7 Samples should be kept in the cooler from the time samples are collected until delivery to the laboratory, however, samples should be refrigerated for longer periods of storage.

4.8 Seal the completed COC form for the appropriate cooler in a plastic bag and tape it to the top lid of the cooler according to SOP 120, *Sample Control and Field Documentation*.

4.9 Securely close the cooler with strapping tape around both ends. To prevent leakage from the cooler, seal cooler drain on outside with duct tape.

4.10 When required, affix signed and dated custody seals at the front left and rear right of the cooler so that anyone opening the lid will break the COC seals.

5.0 PROCEDURES FOR SAMPLE TRANSPORT

5.1 Samples may be hand-delivered to the laboratory by the field team member or may be shipped by commercial carrier (e.g., FedEx, UPS, or Velocity).

5.2 Prepare shipping labels and retain copies of waybills or air bill forms.

5.3 Environmental samples are exempt from all DOT and International Air Transport Authority (IATA) requirements for packaging, shipping papers, labels, and placards.

5.4 Ice chests should be marked “Environmental Samples.”

5.5 Commercial carriers are not required to sign off on the custody forms.

5.6 Inform the laboratory of the carrier name and expected arrival time.

5.7 *Caution*: Do not ship samples such that they are in transit on a holiday weekend.

6.0 REFERENCES

6.1 ASTM. 2002. Standard Practice for Preparation of Sample Containers and for Preservation of Organic Constituents, ASTM F3694, West Conshohocken, PA, 7 pp.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for documenting the traceability of samples collected for site assessments using sample control and field documentation. Documents include container labels, sample collection logs, calibration records, request for analysis forms, chain-of-custody forms, and daily activity logs or field notebooks.

2.0 SCOPE

This SOP will be implemented when documenting field activities and tracking samples. The Field Team Leader (FTL) will ensure that field team members who are engaged in the collection of samples are familiar with sample control and field documentation procedures. Sample control and documentation are necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field.

3.0 PROCEDURE

3.1 Analytical Request

3.1.1 An "Analytical Laboratory Services Request Form" (Attachment A) will be completed for each project.

3.1.2 The FTL will review the form for accuracy with respect to number and type of analyses requested and analytical costs, and fax it to the laboratory at least one week prior to needing sample containers.

3.1.3 Upon receipt of sample containers, the FTL will verify that the correct number of sample containers, and sample containers appropriate for the requested analyses were provided.

3.2 Field Sampling Logbooks

3.2.1 Prior to each sampling event, a sampling logbook consisting of loose-leaf forms, sample logs, daily log, instrument calibration record, the field sampling plan, and site-specific health and safety plan will be prepared. Each section of the field logbook contains consecutively numbered pages. A memorandum may also accompany logbooks with additional instructions for the sampling event.

3.2.2 Indelible black/waterproof ink will be used for recording all data.

3.2.3 All information pertinent to a field activity must be entered into the daily log (Attachment B). This information will include at a minimum:

1. Date
2. Description of general field conditions (e.g., weather conditions);
3. Field observations and pertinent times;
4. Subcontractors and field team members on site;
5. Work performed (including sampling locations);
6. Quality control samples;
7. Problems encountered/corrective action taken;
8. Sketches and calculations pertaining to the job;
9. Supplies and equipment used;
10. Photographic log (if applicable);
11. Decontamination procedures performed;
12. Excursions from approved plans or procedures; and
13. Special notes.

3.2.4 To change an incorrect entry on forms and logs, draw a single line through the entry, write the change above or adjacent to the entry, and date and initial the change. If anyone other than the person to whom a logbook is assigned makes an entry, that person should date and sign the entry.

3.2.5 All project logbooks are to be turned over to the FTL at the end of each work period and to a central file at the end of the field activity.

3.3 Sampling Records

3.3.1 The FTL or designee shall ensure completion of Sampling Records for aqueous samples (Attachment C) or Sampling Records for samples collected from other media, as appropriate (i.e., recording all information pertinent to the collection of sample media on this log).

3.3.2 The FTL shall ensure that information is supplied for all fields provided. Write "N/A" (for "not applicable") in the field as appropriate.

3.3.3 The FTL or designee shall record additional information, as necessary in the daily log. At a minimum, the following data should be recorded for each sample:

1. Names of sample collectors;
2. Identification of sampling location and depth of sample;
3. Depth to groundwater at groundwater sampling locations;
4. Sample collection method;
5. Types and numbers of sample containers used;
6. Preservatives used;
7. Results of field analyses; and
8. Sample observations (color, turbidity, odor, soil type, etc).

3.3.4 The FTL or designee shall complete the Sampling Record by signing it, thus documenting the collection of the sample.

3.3.5 An independent field team member shall review the record to ensure its completeness and accuracy.

3.3.6 For planned but not collected samples, the FTL shall return the sampling record with the words “not collected” written across the forms, ensuring all required signatures are applied.

3.3.7 Documentation specific to general soil sampling includes sample collection depth, areal location of sample, and sample collection device (Attachment B).

3.3.8 Documentation of general sediment sampling includes sample collection depth, areal location of sample, and sample collection device (Attachment B).

3.4 Sample Labeling

3.4.1 A complete sample label shall be filled out for each sample.

3.4.2 Sample labels must identify the sample ID, site, sampler’s initials, sampling location, depth, time, date, and analyses requested.

3.4.3 Labels shall be completed with black waterproof ink and secured to sample containers with clear tape, as necessary.

3.5 Chain-of-Custody (COC)

3.5.1 The FTL or designee is responsible for sample custody from the time of sample collection to receipt at the laboratory, or until samples are shipped by commercial carrier. Sample custody is documented on the lower part of the COC form (Attachment D).

3.5.2 A COC form shall be included with each ice chest shipped to the laboratory.

3.5.3 Complete COC forms in waterproof ink. Corrections are made using a single pen line through errors, and the error is initialed and dated and the correction is entered. Erasures or correction fluid use are not permitted.

3.5.4 Information recorded on COC forms includes:

1. Samples collected and corresponding laboratory analyses;
2. Time and date of sample;
3. Sample number;
4. Type of sample;
5. Sampler's initials;
6. Preservatives used;
7. Special instructions; and
8. Relinquisher's signature, dates, and time.

3.5.5 The FTL or individual not completing the form shall review the COC form and confirm sample label information matches the COC document.

3.5.6 One copy of the COC form is retained by the sampling team, and the other copy is sealed in a ziplock bag attached to the inside lid of the ice chest in accordance with SOP 110, *Sample Handling, Packaging, and Shipment*.

3.5.7 Upon receipt, the laboratory completes and duplicates the form and returns a copy of the form with the analytical data.

3.6 Field Instrument Calibration Log

3.6.1 Acceptable calibration and calibration verification for each instrument shall be documented, linking this record with affected sample measurements.

3.6.2 Results of instrument calibrations are recorded on the Instrument Calibration Form (Attachment E) in the Field Logbook, including:

1. Specific instrument and instrument number;
2. Time and date of calibrations;
3. Names of analyst performing calibrations;
4. Specific standards used;
5. Whether successful calibration occurred; and
6. Corrective actions taken.

3.6.3 Note expiration date for all standards and reagents.

3.7 Documentation Specific to Drum Sampling

3.7.1 Record the following information for each drum sampled:

1. Type of drum and description of contents
2. Drum number, if applicable

3. Terrain and drainage condition
4. Label wording or other markings
5. Dimensional extent of leaks or spills associated with each drum
6. Drum location (or location map).

3.7.2 Record the following information for the drum sample(s):

1. Description of phases, color, crystals, powder, sludge, etc.
2. Stratified layers sampled, including aliquot amounts for composites, if applicable.

3.7.3 Record the following for field testing results on opened drums and drum samples, as appropriate:

1. Background readings for OVA meters
2. Sample readings for OVA meters
3. Type of OVA probe
4. Radiation background reading and sample radiation reading
5. Type of radiation monitor used, if applicable
6. Oxygen and LEL readings from container opening
7. Water reactivity results
8. Specific gravity
9. PCB test results
10. Water solubility results
11. pH of aqueous wastes
12. Results of chemical test strips
13. Ignitability results
14. Results of other chemical hazard test kits
15. Miscellaneous comments for any tests

4.0 ATTACHMENTS

Attachment A: Analytical Laboratory Services Request Form
Attachment B: Daily Log Form
Attachment C: Groundwater Sampling Record Form
Attachment D: FTN Field Data Form
Attachment E: Chain-of-Custody Form
Attachment F: Calibration Record Form

5.0 REFERENCES

5.1 ASTM D4840, Standard Guide for Sampling Chain-of-Custody Procedures

ANALYTICAL LABORATORY SERVICES

PURCHASE ORDER # _____ (Today's Date)

Invoices, correspondence, packing list, and all packages must reference the PO #.

VENDOR: **ACCEPTED BY:**	**CONTACT PERSON:** **TELEPHONE #:**
DATE ORDERED:	**DATE REQUIRED:**

Parameter	Analytical Method	No. Of Analyses	Cost/Analysis	Totals
			SUBTOTAL	
			SHIPPING/HANDLING	
			TAX	
			TOTAL	

PROJECT #: _____

REQUESTED BY: _____

APPROVED BY: _____

R:\WP_FILES\TERMS\LAB\LAB-PO.WP

FTN Associates, Ltd.

3 Innwood Circle Suite 220 Little Rock, AR 72211-2492 (501) 225-7779 Fax (501) 225-6738

Daily Log

Site Location:	Date:
Project Number:	Page of

Groundwater Sampling Record

Facility:	Site ID:	Sampler:
Project Number:	Date:	Sampler Organization:

Site Description

Weather:	Air Temp (ºF):	Wind:

Site type:	Well casing material:				
□ Monitoring Well □ Extraction Well □ Production Well □ Borehole □ Irrigation Well □ Spring □ Other:	□ PVC □ Steel □ Iron □ Other:	Well diameter	inches		Well locked? □ Yes □ No
		Total depth from TOC	feet		
		TOC below/above ground	feet		

Damages/repairs needed:

Water Level Data

Measuring point description: □ Mark/notch on TOC □ North rim of TOC □ Other:		Water level meter: □ Heron Dipper-T □ Slope Water Level Indicator □ Other:					
		Pre-purge initial	Pre-purge confirmation	During purging	Purge end	After sampling	Remarks
Time	24-hour						
Depth to Water	feet						
Product	LNAPL/DNAPL						
Prod. thickness	feet						

Field Data

Field data meters:	Pump description:	Bailer description:
□ Hydrolab MiniSonde □ LaMotte 2020 Turbidimeter □ Hydrolab DataSonde □ Hach 2100P Turbidimeter □ Other: □ Other:	□ Peristaltic □ Bladder (dedicated / portable) □ Submersible	□ Disposable polyethylene □ Disposable Teflon □ Disposable PVC

Purge depth	feet		Well goes dry during purging: □ Yes □ No
Casing vol.	gallons		= [total depth (feet) – depth to water (feet)] ▪ [well ID (inches)^2] ▪ 0.0408

Time	24-hour											Remarks
Purge vol.	gallons											
Purge rate	mL/min											
pH	su											
Temp.	ºC											
Spec. cond.	µS/cm											
D.O.	mg/L											
ORP	mV											
Turbidity	ntu											
Color/tint												
Odor												

Sample Data

Sample ID	Date	Time	# Containers	# Filtered	Remarks

Sampler's Name (print):	Sampler Signature:

FTN FIELD DATA FORM

Field Measurement Record (Date: _____)

Station/ Depth	Measurement			Gage Reading	Temp. °C	DO mg/L	Sp. Cond. *u*S	pH s.u.	Sample S=Sed. W=Wat	# of Con-tainers	Notes
	Date	Time	Who								

Date	Project Name	Project Number	Project Manager (Print)	Page ____ of ____

Laboratory Name	Submitted by:	Parameters (Method Number)	Lab Turn-Around Time
Phone: ( )	FTN Associates, Ltd. 124 W. Sunbridge Dr., Suite 3 Fayetteville, AR 72703 (479) 571-3334 • Fax (479) 571-3338		☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ Other: Due: ___/___/___
Sampler Signature(s)	Recorded By (Print)		

SAMPLE DESCRIPTION

Field Sample Number	Date (mm/dd/yy)	Time (hh:mm)	Matrix*			Number of Containers	Method		Laboratory Notes
			W	S	O		Comp	Grab	

* Matrix: W = Water S = Soil O = Other

Relinquished By (Signature)	Print Name	Date Time	Received By (Signature)	Print Name	Date Time
Relinquished By (Signature)	Print Name	Date Time	Received By Laboratory (Signature)	Print Name	Date Time

Sampler Remarks	Laboratory Remarks:

Calibration Record

Prepared by:					Date:		Time:
Location:					Project Number:		
Type of Meter	Meter Number	Calibration Parameter	Standard Value	Units	Meter Reading	Calibrate to Standard	Comments
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	
						Y or N	

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for the general field decontamination of drilling and sampling equipment. Decontamination procedures must ensure that all equipment contacting a sample during sample collection is free from analytes of interest. The purposes of equipment cleaning include:

1. Prevent contamination of uncontaminated areas;
2. Prevent cross-contamination of sampling locations;
3. Ensure collection of representative samples;
4. Ensure proper operation of field equipment; and
5. Reduce exposure hazards to personnel.

2.0 SCOPE

2.1 This SOP will be implemented when performing decontamination of drilling and sampling equipment. The Field Team Leader (FTL) will ensure that field team members who are engaged in the collection of characterization samples are familiar with sampling equipment field decontamination objectives and procedures. Subcontractors shall follow this SOP for decontaminating drilling and sampling equipment or may use their own procedures(s) subject to approval of the Project Manager. This SOP may be modified to provide flexibility in addressing site-specific situations (e.g., radioactive sites).

2.2 This SOP will be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the decontamination are protected from equipment-related accidents and from exposure to hazardous constituents.

3.0 EQUIPMENT AND MATERIALS

1. Liqui-Nox, Alconox, or non-phosphate equivalent);
2. Analyte-free water;
3. Potable water;
4. Cleaning brushes and containers;
5. Pesticide-grade solvent rinse (isopropanol, hexane, methanol)(Note that methanol is more toxic to the environment).
6. Reagent-grade acid rinse (nitric or hydrochloric); and/or
7. A high-pressure, hot water/steam cleaner.

4.0 PROCEDURES FOR NONSAMPLE-CONTACTING EQUIPMENT

4.1 This procedure applies to drilling rigs, backhoes and support vehicles, augers, drill rods, drill bits, and small tools.

4.2 Equipment shall be cleaned prior to coming on site and between boreholes.

4.3 Large pieces of equipment will be decontaminated in an area specified by the facility. This area must be capable of containing decontamination fluids and allow for managing investigation-derived waste (IDW).

4.4 Remove solid particles from equipment by high-pressure steam cleaning or hand wash with brush using a phosphate-free detergent solution.

4.5 Rinse equipment thoroughly with potable water.

4.6 Allow equipment to air-dry, unless it is reused immediately.

4.7 An optional rinse with a pesticide-grade solvent may be used to remove coatings of organic contaminants followed by rinsing with a reagent-grade or deionized water.

4.8 Unless small tools are going to be used immediately, they must be wrapped in new aluminum foil or plastic to keep them clean until needed.

4.9 IDW will be managed as outlined in SOP 140, *Management of Investigation-Derived Wastes*.

5.0 PROCEDURES FOR SAMPLE-CONTACTING EQUIPMENT

5.1 Sample-contacting equipment should be cleaned prior to use and between sampling locations (e.g. monitoring wells).

5.2 Wash with detergent solution. For surfaces of equipment that cannot be adequately disassembled and cleaned (e.g., pumping equipment tubing), circulate decontamination solutions through equipment.

5.3 Rinse with potable water.

5.4 Rinse with desorbing agent. Inorganic desorbing agents include 10% nitric acid and 10% hydrochloric acid. Organic desorbing agents include pesticide-grade isopropanol, acetone, hexane, and methanol.

5.5 Rinse with analyte-free or deionized water (not distilled water). Allow all water from final rinse to drain from pumps/tubing before reuse.

5.6 Allow equipment to air dry, unless it is reused immediately.

5.7 Wrap equipment, where appropriate, with inert material (aluminum foil or plastic wrap) or place in zipper-sealed bags for transport to prevent contact with potentially contaminated material.

5.8 Do not attempt to clean or reuse sample filtration media, sample containers, bailer rope, rubber hoses, or plastic gloves.

6.0 FIELD INSTRUMENTS

Follow manufacturer's recommendations for cleaning instruments. At a minimum:

6.1 Wipe down equipment body, probes, and cables with detergent solution. Check manufacturer's instructions for recommendations and/or restrictions on cleaning.

6.2 Rinse thoroughly with potable water.

6.3 Rinse with analyte-free water.

6.4 Store equipment according to the manufacturer's recommendation or wrap equipment in aluminum foil or untreated plastic bags to eliminate potential contamination.

7.0 CLEANING PROTOCOL QA/QC

7.1 Clean equipment prior to coming on site.

7.2 Use disposable equipment (bailers, tubing, etc) where possible.

7.3 Use high-grade, analyte-free cleaning solutions.

7.4 Keep equipment off the ground to prevent contamination once equipment is cleaned (i.e., plastic sheeting, metal horses for augers, etc.).

7.5 Segregate clean and contaminated equipment.

7.6 Follow SOP 150, *Field Quality Control Samples*, to document the effectiveness of decontamination methods.

8.0 REFERENCES

1. ASTM 2002. Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites; D5088, ASTM, West Conshohocken, PA.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for managing IDW generated during site assessment activities. This process includes handling, storing, characterizing, and disposing of IDW.

2.0 SCOPE

This SOP shall be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

3.0 EQUIPMENT AND MATERIALS

1. DOT-approved drums and containers;
2. Indelible marker (i.e., Sharpie) or paint markers;
3. Clear adhesive tape;
4. Hazardous Waste Labels (where applicable);
5. Hammer, ratchet, socket, and crescent wrenches;
6. Plastic buckets; and
7. Container Storage Log sheet.

4.0 PROCEDURE

4.1 Management of Soil and Aqueous IDW

4.1.1 The Project Manager or designee will prepare a site-specific IDW plan checklist (Attachment A), which will be taken into the field by the Field Team Leader (FTL).

4.1.2 The Field Team Leader (FTL) shall monitor the proper implementation of this procedure.

4.1.3 The FTL and appropriate facility personnel will identify container management and temporary storage areas prior to the start of field operations that generate wastes.

4.1.4 Excess soil will be placed in DOT-approved drums or containers separate from drums containing purge and decontamination water.

4.1.5 Lids and gaskets and/or bungs will be placed on containers and secured when not in active use.

4.1.6 Each container of waste generated shall be individually labeled. An indelible marker and adhesive label may be used for this purpose, or

information may be placed directly on the container with a paint marker. Information placed on containers shall include:

1. The drum or container identification used in tracking the containers at the site;
2. Contents (i.e., soil, purge water, decontamination water);
3. Accumulation start date; and
4. The phrase "Analysis Pending" (optional).

4.1.7 Containers will be temporarily stored at the facility pending laboratory analysis.

4.1.8 The storage and final disposition of containers will be documented on the container storage log sheet (Attachment B).

4.2 IDW Characterization

4.2.1 Groundwater analytical data will be used for disposal characterization of aqueous wastes.

4.2.2 The disposition of soil IDW will be based in the results of borehole soil analysis or collection of a composite sample of IDW contained in drums.

4.2.3 One composite sample will be collected for every 5 drums of IDW containing soil cuttings.

4.2.4 Where appropriate, "total" values for the soil samples (assuming they are greater than 0.5% solids) will be divided by 20 for comparison with Toxicity Characteristic Leaching Procedure (TCLP) regulatory levels (Ref. 1). A factor of 20 is used to account for the dilution that occurs in the TCLP test.

4.2.5 Groundwater and soil data that are below TCLP regulatory levels, thus indicative of non-hazardous waste will then be compared to EPA Region 6 HHMSSLs (Ref. 2).

4.2.6 Soil samples having total concentrations indicating that TCLP levels will be exceeded will be further evaluated using TCLP analysis (EPA Method 1311) for the applicable analytical parameters.

4.3 IDW Disposal

4.3.1 Aqueous wastes having concentrations below EPA Region 6 HHMSSLs will be considered non-contaminated IDW and discharged to the ground.

4.3.2 Soil IDW having concentrations below these screening levels will be discharged to the ground, transported to a Class 1 landfill for disposal, or otherwise handled depending on the needs of the facility.

4.3.3 Aqueous wastes having concentrations above EPA Region 6 HHMSSLs will either be discharged to the POTW collection system with permission of the POTW's Industrial Pre-Treatment Coordinator, or transported offsite to an appropriate disposal facility.

4.3.4 Soil IDW having concentrations above EPA Region 6 HHMSSLs but below TCLP levels will be transported to an appropriate facility for treatment or disposal.

4.3.5 Soil IDW having concentrations above TCLP levels will be transported to an appropriate hazardous waste facility for treatment or disposal.

4.3.6 If requested, FTN will coordinate directly with an approved disposal facility for the transportation and disposal of IDW.

4.3.7 Signing of waste profile sheets and shipping manifest will be the responsibility of the facility unless FTN's is its authorized representative.

4.3.8 The facility must complete the Generator Authorization Form (Attachment C) for FTN to act as the facility's agent in these matters.

4.4 PPE and Disposable Sampling Equipment Waste

4.4.1 Excess solid and liquid waste will be removed from personal protective equipment (PPE) and disposable sampling equipment.

4.4.2 PPE and disposable sampling equipment will be placed and sealed in 55-gallon drums. Disposal alternatives will be evaluated pending analytical results for each individual site.

5.0 ATTACHMENTS

Attachment A: Site-Specific Investigation-Derived Waste Plan Checklist

Attachment B: IDW Container Storage Log

Attachment C: Generator Authorization Form

6.0 REFERENCES

1. EPA. 1986. Test Methods for Evaluating Solid Waste-Physical/Chemical Methods SW-846. Method 1311 and 40 CFR 261.24, Table 1.

2. EPA (2004). EPA Region 6 Human Health Medium-Specific Screening Levels (2004-2005).

Site-Specific Investigation-Derived Waste Plan Checklist
Site: _____

1.	IDW Media	☐ Soil cuttings ☐ Well development or purge water ☐ Decontamination residual soil and wastewater ☐ PPE or disposable equipment ☐ Other: _____
2.	Expected Regulatory Status	☐ Hazardous ☐ Solid Waste ☐ Unknown ☐ Other (Waste management activities regulated by OSHA Hazwoper standard 1910.120)
3.	Site Location	☐ To be determined
4.	Nature of Contaminants Expected	☐ Petroleum contamination ☐ Polyaromatic hydrocarbon ☐ Pesticides ☐ Herbicides ☐ PCBs ☐ Metals ☐ Other – Contaminant concentrations from the previous analytical results were very low for all of the above.
5.	Volume of IDW Expected	☐ Drums – Maximum of ___. ___ for decontamination fluids, ___ for drill cuttings, and ___ for PPE and other disposable items. ☐ Cubic yards ☐ Tons ☐ Gallons
6.	Compositing Strategy for Sample Collection	☐ No IDW sampling planned. Will base disposal decisions on analytical results from sampling.
7.	IDW Storage	☐ As per SAP ☐ Other: _____
8.	Waste Disposal	☐ As per SAP ☐ Other: _____

IDW Container Storage Log

Page _____ of _____

Project #:	Project Name/Location:
Container Size:	Construction Material:

Container Number	Boring Number	Contents	Date Filled		Location Moved To	Final Disposition
			First	Last		

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, Arkansas 72211

GENERATOR/BROKER AUTHORIZATION FORM

Date: _____ RE: _____

To Whom It May Concern:

Please be advised that FTN Associates, Ltd., located in Little Rock, Arkansas, has been appointed to work as our broker/contractor for purposes of disposing and/or recycling hazardous and/or non-hazardous waste that we may generate. FTN Associates, Ltd. personnel are hereby permitted to act as our authorized agent for the following purposes:

1. Sign waste profile sheets, shipping manifest and contracts to dispose, recycle and/or transport waste.
2. Sign recertifications and/or amendments to waste profile sheets.

FTN Associates, Ltd. will notify us prior to any action authorized above and will provide us with copies of any documents bearing our name to which amendments or signatures have been made under this authorization.

_____ _____
Name (print) Title

_____ _____
Signature Company

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the requirements for the collection of field quality control (QC) samples to ensure the reliability and validity of field and laboratory data. This procedure is applicable to sampling and analysis plans (SAPs) that include the collection of environmental samples.

2.0 SCOPE

2.1 Sampling procedures outlined in the SAPs are applied to field QC samples in the same way they are applied to regular field samples.

2.2 Field QC sample containers must be labeled and transported and the samples analyzed, in a manner identical to all other samples taken at a site. Once collected they must remain with the sample set until the laboratory has received them.

2.3 Except for trip blanks, prepare all quality control samples on site in the field.

2.4 Use the following SOPs in conjunction with SOP 150:

- SOP 110, *Sample Handling, Packaging, and Shipment,*
- SOP 120, *Sample Control and Field Documentation.*

3.0 EQUIPMENT AND MATERIALS

Equipment required to implement this procedure is listed on the Equipment and Materials list found in applicable FTN SOPs.

4.0 FIELD QC SAMPLE TYPE AND PURPOSE

4.1 Field duplicates are collected to evaluate the reproducibility of the sampling technique.

4.2 Equipment rinsate blanks are collected to evaluate decontamination procedures. Collect these blanks using sampling equipment that has been cleaned in the field.

4.3 Field blanks are collected to monitor on site sampling environment, the suitability of sample preservatives and analyte-free water, and sample transport and storage conditions. Field blanks are not required if equipment blanks are collected.

4.4 Trip blanks are collected to determine volatile organic compound (VOC) contamination during storage and transport.

5.0 FIELD QC SAMPLE FREQUENCY

5.1 Field duplicates are collected one per day per matrix type or 1 per 10 samples, which ever is more frequent.

5.2 Equipment blanks and field blanks are collected one per day or 1 per 20 samples collected which ever is more frequent.

5.3 A trip blank accompanies each cooler containing VOC samples.

5.4 The method or project may require collection of additional quality control samples.

5.5 At times, split samples may be specified in a SAP. Split samples measure the variability between laboratories. Therefore, the laboratory samples must be subsamples of the same parent sample and every attempt must be made to ensure sample homogeneity. Collecting split samples for soils, sediments, chemical wastes and sludge is not recommended because a true split sample in these matrices is not practicable.

6.0 PROCEDURE

6.1 Field Duplicates

Collect two separate samples from the same source and at the same location and time. Place the samples in separate container, label each as a unique sample, and submit both samples for the same analyses. When possible, collect duplicate samples from sampling locations where contamination is present. Duplicates may be prepared as "blind" samples by assigning a location code that does not indicate it is a duplicate sample.

6.2 Equipment Rinsate Blank

After decontaminating the field sampling equipment, rinse with deionized water and collect the rinsate for analysis. Assure that all equipment surfaces that come in contact with the sampling materials are rinsed (e.g., inside of a bailer). Do not use tap water or drinking water purchased from a local store, as these sources typically contain trihalomethanes and inorganics.

6.3 Field Blanks

Collect field blanks if no equipment blanks are prepared. The sample container is used to collect the samples by pouring deionized water directly into the sample container.

6.4 Trip Blanks

Trip blanks contain reagent-grade water and are prepared by the laboratory and received along with requested sample containers. Do not open the trip blanks. Trip blanks are analyzed for VOCs.

6.5 Split Samples - Water

Fill the sample container from consecutive sample volumes from the same sampling device. If the sampling device does not hold enough sample to fill the sample container, use the following procedure:

1. Fill the first container with half of the sample, and pour the remaining sample into the second container.
2. Obtain an additional sample, pour the first half into the second container, and pour the remaining portion into the first container.
3. Continue with Steps 1 and 2 above until both containers are filled.

7.0 QC DOCUMENTATION

7.1 The Field Team Leader (FTL) is responsible for maintaining permanent QC sample records.

7.2 At a minimum, the daily log should include deviations (if applicable), type of analyte-free water used, and a listing of equipment and locations where blanks were prepared.

7.3 Duplicate samples should be shown on Sampling Record Forms.

7.4 Chain-of-Custody documentation should be completed.

8.0 REFERENCES

8.1 EPA Region 4, 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, November 2001.

8.2 EPA, 1986. RCRA Ground Water Monitoring Technical Enforcement Guidance Document, OSWER, Washington D.C.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process for developing site survey data. Survey personnel who perform control, property, easement, or boundary surveys must be registered professional land surveyors. A registered land surveyor will survey property boundaries, when required. Surveys may also be conducted to develop site maps and provide coordinates for sampling locations.

2.0 SCOPE

2.1 This SOP will be implemented when provided coordinates for sampling sites.

2.2 This SOP will be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.3 The site-specific work plan will identify survey needs.

3.0 EQUIPMENT AND MATERIALS

The surveying subcontractor will supply all equipment and materials that will be used during site surveys. All sample locations will be staked and identified on a site map that will be provided to the surveyor. The surveying subcontractor may use either traditional survey techniques or a global positioning system (GPS) to obtain acceptable survey data.

4.0 PROCEDURE

4.1 The Project Manager or designee shall determine the type of survey to be performed and gather information that will assist survey personnel in location identification (e.g. a map marking sampling locations).

4.2 Survey coordinates (horizontal) shall be measured to an accuracy of ±1 foot in reference to the State Plane Coordinate System, facility coordinate system, or assumed coordinate system.

4.3 All elevation data (i.e., ground surface and reference point elevations such as top of casing) will be measured to the nearest 0.01foot.

4.4 For monitoring wells or piezometers, the top of casing (north side) will be identified with a mark (e.g., v-notch, hole), and this mark will be measured to the nearest 0.01foot relative to site datum, the National Geodetic Vertical Datum of 1929, or the North American Vertical Datum of 1988.

4.5 At least one control point will be established to meet any future survey requirements.

4.6 Survey personnel shall document the survey by maintaining handwritten field notebooks and recording, at a minimum, the names of control points used, intermediate traverse points, the sequence of measurements made, and brief descriptors of the points measured.

4.7 Survey personnel shall prepare a plot of the points located by the survey and identify each location point with a surveyor's point label.

1.0 PURPOSE

This Standard Operating Procedure (SOP) specifies methods for collection and screening of representative soil samples during field investigations.

2.0 SCOPE AND COMMENTS

2.1 Use this SOP to collect soil samples that are representative of site conditions. It is important to ensure that the collected samples are neither altered nor contaminated by sampling and handling techniques.

2.2 This SOP will be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.3 This SOP covers general soil sampling for chemical analysis. Sampling locations, analytical parameters, and other requirements are specified in the site-specific work plan or sampling and analysis plan (SAP).

2.4 Use the following SOPs in conjunction with SOP 310:

- SOP 110, *Sample Handling, Packaging, and Shipment*
- SOP 120, *Sample Control and Field Documentation*
- SOP 130, *Decontamination of Drilling and Sampling Equipment*
- SOP 140, *Management of Investigation-Derived Wastes*
- SOP 410, *General Drilling Operations in Unconsolidated Materials Using a Hollow Stem Auger (HSA) or Direct Push Technology (DPT).*

2.5 If background sampling is warranted and feasible as determined in the site's work plan, select an up gradient, undisturbed location for obtaining the background samples. Be aware that differences in soil types may affect these background samples (e.g., sand versus clay).

2.6 Do not use samples that are collected for lithologic or vapor determinations for chemical analyses.

2.7 Do not collect samples for chemical analysis from auger flights or cuttings from hollow stem auger flights, except for waste characterization of investigation-derived wastes.

2.8 Obtaining a good sample for chemical analysis is the first priority, therefore, collect chemical samples for volatile organic compounds (VOCs) before logging soil cores.

3.0 EQUIPMENT AND MATERIALS

3.1 Use sampling equipment constructed of materials that are compatible with the analytes of interest.

3.2 Refer to the site-specific work plan for information on sample container size and construction, and preservation and holding times.

3.3 For information on decontamination materials see SOP 130, *Decontamination of Drilling and Sampling Equipment*.

3.4 For information on documentation materials see SOP 120, *Sample Control and Field Documentation*.

3.5 Other equipment and materials may include photoionization detector (PID), disposable gloves, stainless steel mixing dishes, stainless steel sampling spoons and knives, sample coolers and ice, and waste containers as specified.

4.0 GENERAL PROCEDURE

Surface soil is generally classified as soil between the ground surface and 6-12 inches below ground surface, unless otherwise indicated in the site-specific SAP. The subsurface interval begins approximately 12 inches below ground surface. Use the following steps for sample collection:

4.1 Remove leaves, grass, and surface debris from the area to be sampled.

4.2 Select means of reaching the appropriate sampling depth. Procedures for reaching the appropriate depth are presented in subsequent sections.

4.3 Select an appropriate pre-cleaned sampling device and collect the sample.

4.4 Transfer the sample to the appropriate sample container. If contamination is derived from petroleum products it is acceptable to use a clean, gloved hand to transfer the sample(s) to the sample containers.

4.5 If VOC analysis is required, pack the sample to completely fill the sample container and reduce the amount of headspace.

4.6 Clean the outside of the sample container to remove excess soil.

4.7 Label the sample container, place on ice to preserve to 4^{o}C and complete field notes.

5.0 SHOVELS AND DIGGERS

This equipment is used for soils approximately 12 inches deep to a point when using the implement becomes impractical.

5.1 Dig a hole or trench to the required depth.

5.2 Follow sample collection procedures in Section 4.3 through 4.6.

6.0 BACKHOE

Used for soil approximately 12 inches deep to a point when using the implement becomes impractical (approximately 10 ft).

6.1 Dig a trench to the appropriate depth.

Expose the sample in the trench by using a pre-cleaned spoon, spatula, or equivalent to clean away the soil that came in contact with the backhoe bucket. There is a safety issue with collecting samples from a trench deeper than 5 feet. Adequate protective system is required except when excavations are less than 5 feet in depth and examination of the ground by a competent person provides no indication of a potential cave-in. Samples can be collected from the bucket or soil piles at the surface.

6.2 Use a second pre-cleaned utensil to actually collect the sample from the trench, backhoe bucket, or soil pile.

6.3 Follow procedures in Section 4.3 through 4.6 to collect the sample.

7.0 BUCKET AUGERS AND HOLLOW CORERS

Suitable to reach soils from approximately 12 inches to a point when using the implement becomes impractical.

7.1 Push and rotate the auger into the soil until the bucket is filled.

7.2 Addition of a non-contaminating sleeve may allow an undisturbed soil sample to be obtained. If use, remove the sleeve from the auger and cap.

7.3 If the auger hole is prone to collapse due to low cohesion in some soils, insert a temporary PVC casing into the hole. The casing prevents hole collapse and minimizes cross-contamination between soil zones as the auger is advanced. After collecting the samples, remove the temporary casing (if used) and fill the hole with excavated soil.

7.4 Remove the sample from the sampler by pushing or scraping the soil with an appropriate pre-cleaned utensil into aluminum foil.

7.5 Remove any portion of the sample that has been disturbed and discard.

7.6 Follow sample collection procedures as outlined in Section 4.3 through 4.6.

8.0 SPLIT-SPOON SAMPLER

Suitable for reaching soils from approximately 12 inches to depths greater than 10 feet.

8.1 Advance the sampler using the weight of the drilling stem and rods or a mechanical hammer.

8.2 Insert a catcher device in the head ring to prevent loss of unconsolidated sample during recovery.

8.3 After retrieving the sampler, expose the soil by unscrewing the bit and head rings and splitting the barrel.

8.4 If recovery is enough to accommodate discarding a portion of the sample, discard the top two to three inches.

8.5 If PID screening is required, refer to Section 12.0.

8.6 For VOC analysis, collect the sample from the center portion of the split spoon. Slice the sample from the center portion of the split spoon using a clean utensil.

8.7 Follow sample collection procedures as outlined in Section 4.3 through 4.6.

8.8 Ream out the interval previously sampled interval and repeat the procedure until total depth is reached.

9.0 CONTINUOUS SAMPLER

A continuous sampler is used when extensive sampling and or/ relatively undisturbed samples are required. It's use requires special drill bits and drill stem that allows the 5-ft split barrel sampler to be lowered through the drill stem and locked into place where the bottom of the sampler extends ahead of the auger. The sampler is pressed ahead of the drill stem as the borehole is advanced. After the desired depth is reached and the sampler is retrieved, select samples from the desired depth and follow sample collection procedures in Section 8.5 through 8.8. Using a continuous sampler eliminates the step required to ream the sampled interval before the next sample can be collected.

10.0 SHELBY TUBE

Used to sample unconsolidated soil and consists of a tube approximately 30 inches long and two inches (or larger) in diameter.

10.1 After drilling to the required depth, a soil sample is obtained by pushing the tube into the soil using the drilling rig's hydraulic ram or manually with a sledgehammer.

10.2 Extrude the sample from the Shelby tube.

10.3 Use a decontaminated utensil to remove any portion of the sample that has been disturbed.

10.4 Collect samples for VOC analysis from the center portion of the tube.

10.5 For other analyses, slice the sample from the center portion of the tube using a clean, decontaminated utensil.

10.6 Follow Section 4.3 through 4.6 in handling the sample.

11.0 DIRECT PUSH SAMPLING

Suitable for reaching soils from approximately 12 inches to depths greater than 10 feet, depending on the DPT rig and the soil type that is encountered.

11.1 Place a clear liner inside the metal probe rod.

11.2 Select drive-shoe with an opening appropriate for the site lithology, screw it on the probe rod, and advance the rod a full probe length.

11.3 Retrieve the rod and remove the drive shoe and liner.

11.4 Slice the liner to expose the soil.

11.5 Trim the samples on all sides where practical.

11.6 If PID screening is required, refer to Section 12.0.

11.7 Follow procedures described in Section 4.3 through 4.6 for sample collection.

11.8 If the total recovered sample volume is insufficient for both screening and laboratory analysis, a second hole will be pushed as close as possible to the original hole and an additional sample will be taken from the same depth interval. Any additional holes will be pushed within 5 feet of the original location, where feasible.

12.0 HEADSPACE SCREENING FOR VOCS USING A PID

12.1 Calibrate the PID instrument each day to the manufacturer's standard for instrument operation. Follow procedures in the manufacturer's operations manual.

12.2 Two separate representative aliquots will be collected at each sampling interval. One of the aliquots will be placed and sealed in a glass jar or plastic bag for headspace screening of VOCs with a PID. Allow space (the container is one-third to one-half empty) for ambient air.

12.3 Seal and gently shake the container to expose the soil to the air trapped in the container.

12.4 Allow the sealed container to set for a minimum of 5 minutes (depending on ambient temperatures) while vapors equilibrate.

12.5 Measure the vapors present within the sample bag headspace by inserting the probe of the PID in a small opening in the bag or through foil on the jar.

12.6 Record all readings in the field logbook. Record readings as ppm.

12.7 Measure and record background readings. The background reading is the reading of ambient air outside the sample container.

12.8 Under no circumstances immerse the probe tip assembly in fluid. In some field applications, with the exception of the probe's inlet and exhaust, wrap the PID in clear plastic to prevent contamination and to prevent water from getting inside in the event of precipitation.

12.9 PID screening may require initially filling more sample bottles than will be submitted for analysis and discarding extra samples after headspace analysis

13.0 RECORDS

The Field Geologist or designee is responsible for maintaining permanent QC sample records. Note all visible contamination, odor, PID measurements, or any observed evidence of contamination in the sample. Log subsurface boreholes in accordance with SOP 410, *General Drilling Operations in Unconsolidated Materials Using a Hollow Stem Auger (HSA) or Direct Push Technology (DPT).*

13.1 Sample Collection Record
13.2 Boring Log
13.2 Daily Log
13.3 Chain-of-Custody documentation

14.0 REFERENCES

14.1 EPA Region 4. 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, November 2001.

14.2 EPA, 1986. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods EPA SW-846, as amended by updates (December 1996).

14.3 EPA, 1986. RCRA Ground Water Monitoring Technical Enforcement Guidance Document, OSWER, Washington D.C.

1.0 PURPOSE

This Standard Operating Procedure (SOP) specifies methods for collection of samples which will be representative of groundwater quality.

2.0 SCOPE

2.1 Use this and associated SOPs to collect groundwater samples. They are designed to ensure that the collected samples will be representative of water in the aquifer or target formation and that the samples have not been altered or contaminated by the sampling and handling procedures. These procedures apply to permanently and temporarily installed monitoring wells, DPT probe holes, and excavations where groundwater is present.

2.2 This SOP shall be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.3 Sampling locations, analytical parameters, and other requirements are specified in the site-specific work plan or sampling and analysis plan (SAP).

2.4 Use the following SOPs in conjunction with SOP 320:

- SOP 321, *Well Purging*
- SOP 322, *Field Testing Using the HydroLab MiniSonde or DataSonde with a Flow-Through Cell*
- SOP 610, *Water Level Measurements*
- SOP 110, *Sample Handling, Packaging, and Shipment*
- SOP 120, *Sample Control and Field Documentation*
- SOP 130, *Decontamination of Drilling and Sampling Equipment*
- SOP 140, *Management of Investigation-Derived Wastes*

3.0 EQUIPMENT AND MATERIALS

3.1 Use groundwater purging and sampling equipment (peristaltic, bladder, or submersible pumps, bailers) constructed of only non-reactive, non-leachable materials that are compatible with the environment and the selected analytes.
3.2 Water level measuring device
3.3 Flow-through cell (if applicable)
3.4 Flow measurement supplies (if applicable)
3.5 Sample containers and preservatives
3.6 Field Parameter Meters
3.7 Photoionization Detector (PID) (if applicable)

3.8 Personal protective clothing and equipment
3.9 Field logbook
3.10 Cooler with ice

4.0 PROCEDURE

4.1 Conduct Initial Inspection

4.1.1 Verify the identification of the monitoring well by examining markings, sign plates, placards or other designations.

4.1.2 Remove the well cover and remove all standing water around the top of the well casing (manhole) before opening the well cap.

4.1.3 Inspect the exterior protective casing of the monitoring well for damage and document the results of the inspection if there is a problem.

4.1.4 It is recommended that you place a protective covering around the wellhead. Replace the covering if it becomes soiled or ripped.

4.1.5 Inspect the well lock and determine whether the cap fits tightly. Replace the cap if necessary.

4.2 Record water level measurements in monitoring wells, determine total depth of well, and water well volume. Follow procedures in SOP 610, *Water Level Measurements*.

4.3 Purge and sample monitoring wells in order of least to the most contaminated if chemistry is known, or up gradient to down gradient if unknown.

4.4 Purge monitoring wells by using the well volume method or low-flow minimal drawdown and field parameter stabilization technique, or as specified in the site-specific work plan or facility groundwater monitoring plan. Follow procedures in SOP 321, *Well Purging*.

4.5 If sampling for VOCs, reduce pumping rate to 0.05 L/min.

4.6 Fill each 40-ml VOA vial with groundwater taken care not to let it overflow and lose preservative. Place cap with Teflon septum on each vial as filled. Turn the VOA vial upside down and check for air bubbles. Tap the bottom of the VOA vials to dislodge any bubbles that may have formed around the cap or sides. If bubbles are present, remove cap and fill VOA vial with additional sample water. Reconfirm that there are no bubbles in vial.

4.7 Fill sample containers for other analytes, and seal sample containers. Follow the site-specific SAP or EPA (1991) guidelines on order of sample collection, as follows:

1. Volatile organic compounds (VOCs)
2. Semi-volatile organics (SVOCs)
3. Gas-sensitive parameters (e.g., ferric iron, alkalinity, cyanide)
4. Samples requiring field filtration
5. Inorganic parameters (e.g. metals).

4.8 Filtered groundwater samples can only be collected with approval from ADEQ or if approved under permits, orders, and site assessment programs. Filtered groundwater samples are required for specific parameters collected under Monitored National Attenuation sampling plans.

4.9 Place labeled sample container(s) into a cooler with ice. Follow SOP 110, *Sample Handling, Packaging, and Shipping*.

4.10 Record samples in field logbook and complete chain-of-custody per SOP 120, *Sample Control and Field Documentation*.

5.0 RECORDS

The Field Team Leader (FTL) is responsible for maintaining permanent QC sample records.

5.1 Sample Collection Record
5.2 Daily Log
5.3 Chain-of-Custody documentation

6.0 REFERENCES

6.1 EPA, 1991. Handbook: Ground Water, Volume II: Methodology, USEPA Office of Research and Development, Center for Environmental Research Information, EPA/625/6-90-166, 141 pp.

6.2 Puls, R.W., and M. Barcelona, 1996. Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures. Ground Water Issue, OSWER EPA/540/S-95/504.

1.0 PURPOSE

This Standard Operating Procedure (SOP) specifies methods for collection of samples that will be representative of the groundwater being sampled.

2.0 SCOPE

2.1 Use this SOP to collect groundwater samples. It is designed to ensure that the collected samples will be representative of water in the aquifer or target formation and that the samples have not been altered or contaminated by the sampling and handling procedures. These procedures apply to permanently and temporarily installed monitoring wells and excavations where groundwater is present.

2.2 This SOP shall be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.3 Use the following SOPs in conjunction with SOP 321:

- SOP 320, *Groundwater Sampling*
- SOP 610, *Water Level Measurements*
- SOP 322, *Field Testing Using the HydroLab MiniSonde or Datasonde with a Flow-Through Cell*
- SOP 120, *Sample Control and Field Documentation*
- SOP 130, *Decontamination of Drilling and Sampling Equipment*
- SOP 140, *Management of Investigation-Derived Wastes*

3.0 Equipment and Materials

Use groundwater purging and sampling equipment constructed of only non-reactive, non-leachable materials that are compatible with the environment and the selected analytes. In selecting groundwater purging and sampling equipment, give consideration to the depth of the well, the depth to groundwater, the volume of water to be evacuated, the sampling and purging technique, and the analytes of interest.

3.1 Flow Container — Use a flow-through cell or container when collecting measurements for purging stabilization. The design must ensure that fresh formation water continuously contacts the measuring devices and does not aerate the sample or otherwise affect the groundwater properties.

3.2 Pumps — Pumps or pump tubing must be lowered and retrieved from the well slowly and carefully to minimize disturbance to the formation water. This is especially critical at the air/water interface. Avoid the resuspension of sediment particles (turbidity) at the bottom of the well or adhered to the well casing during positioning of the pump or tubing.

3.2.1 Peristaltic Pump — Use a variable speed peristaltic pump to purge groundwater from wells when the static water level in the well is no greater than 20-25 feet below ground surface (bgs). If the water levels are deeper than 18-20 feet bgs, the pumping velocity will decrease.

A variable speed peristaltic pump can be used for normal purging and sampling, sampling low permeability aquifers or formations, and collecting filtered groundwater samples.

Most analyte groups can be sampled with a peristaltic pump if the tubing and pump configurations are appropriate.

3.2.2 Submersible Pumps — Variable Speed Electric Submersible Pump: A variable speed submersible pump can be used to purge and sample groundwater from 2-inch and larger internal diameter wells.

A variable speed submersible pump can be used for normal purging and sampling, sampling low permeability aquifers or formations, and collecting filtered groundwater samples.

Make sure that the pump housing, fittings check valves and associated hardware are constructed of stainless steel. Install a check valve at the output side of the pump to prevent back flow. Make sure that any other materials are compatible with the analytes of interest.

If purging and sampling for organics:

- The entire length of the delivery tube must be Teflon, Polyethylene or Polypropylene (PP) tubing.
- The electrical cord must be sealed in Teflon, Polyethylene or PP and any cabling must be sealed in Teflon, Polyethylene or PP, or be constructed of stainless steel.
- All interior components that contact the sample water (impeller, seals, gaskets, etc.) must be constructed of stainless steel or Teflon.

3.2.3 Bladder Pumps — A variable speed positive displacement bladder pump (no-gas contact) can be used to purge and sample groundwater from 3/4-inch and larger internal diameter wells.

A variable speed bladder pump can be used for normal purging and sampling, sampling low permeability aquifers or formations, and collecting filtered groundwater samples.

The bladder pump system is composed of the pump, the compressed air tubing, the water discharge tubing, the controller and a compressor or compressed gas supply.

The pump consists of a bladder and an exterior casing or pump body that surrounds the bladder and two (2) check valves. These parts can be composed of various materials, usually combinations of polyvinyl chloride (PVC), Teflon, Polyethylene, PP and stainless steel. Other materials must be compatible with the analytes of interest.

If purging and sampling for organics:

- The pump body should be constructed of stainless steel and the valves and bladder should be Teflon or Polyethylene.
- The entire length of the delivery tube must be Teflon, Polyethylene or PP.
- Any cabling should be sealed in Teflon, Polyethylene or PP, or be constructed of stainless steel.

Permanently installed pumps may have a PVC pump body as long as the pump remains in contact with the water in the well.

3.3 Bailers

3.3.1 Purging — Use a bailer if there is non-aqueous phase liquid (free product) in the well or non-aqueous phase liquid is suspected to be in the well. Use of bailers for purging is not recommended unless no other equipment can be used or a permit or order has specifically authorized purging with a bailer because bailing:

1. Introduces atmospheric oxygen, which may precipitate metals or cause other changes in the chemistry of the water in the sample (e.g. pH).
2. Agitates groundwater, which may bias volatiles and semi-volatile organic analyses due to volatilization.
3. Agitates the water in the aquifer and re-suspends fine particulate matter.
4. Surges the well loosening particulate matter in the annular space around the well screen.
5. May introduce dirt into the water column if the sides of the casing wall are scraped.

3.3.2 Sampling — Bailers may be used to routinely collect some analyte groups or under specific circumstances for other analyte groups.

3.3.3 Construction and Type — Bailers must be constructed of materials compatible with the analytes of interest. Stainless steel, Teflon, Polyethylene and PP bailers may be used to sample all analytes.

3.3.4 Use of disposable bailers is required when sampling grossly contaminated sample sources.

3.3.5 Use dual check valve bailers when collecting samples.

3.3.6 Use bailers with a controlled flow bottom when collecting volatile organic samples.

3.3.7 Contamination prevention includes:

1. Keeping the bailer wrapped (foil, butcher paper, etc.) until just before use.
2. Using protective gloves to handle the bailer once it is removed from its wrapping.
3. Handling the bailer by the lanyard to minimize contact with the bailer surface.

3.4 Lanyards

3.4.1 Lanyards must be made of non-reactive, non-leachable material. They may be cotton twine, nylon, stainless steel, or may be coated with Teflon, Polyethylene or PP.

3.4.2 Discard cotton twine, nylon, and non-stainless steel braided lanyards after sampling each monitoring well.

3.4.3 Decontaminate stainless steel, coated Teflon, Polyethylene and PP lanyards between monitoring wells. They do not need to be decontaminated between purging and sampling operations.

4.0 Procedure

4.1 Conduct initial inspection as described in SOP 320, *Groundwater Sampling.*

4.2 Record water level measurements in monitoring wells and determine total depth of well. Follow procedures in SOP 610, *Water Level Measurements*.

4.3 Calculate the total volume of water in the well using the following equation:

$$\mathbf{V = (0.041)d^2 \times h}$$

Where: V = volume in gallons
d = well diameter in inches
h = height of the water column in feet

4.4 The total volume of water in the well may also be determined with the following equation by using a casing volume per foot factor (gallons per foot of water) for the appropriate internal well diameter:

V = [Gallons per Foot of Water] x h

Where: V = volume in gallons
h = height of the water column in feet

Casing Internal Diameter	Approximate Gallons per Foot of Water
0.75"	0.02
1"	0.04
1.25"	0.06
2"	0.16
3"	0.37
4"	0.65
5"	1.02
6"	1.47
12"	5.88

4.5 Record all measurements and calculations in the field records.

4.6 Purge monitoring wells by using the volume of water (Section 5.0) and/or field parameter stabilization technique (Section 6). The selection of the purging technique and equipment is dependent on the hydrogeologic properties of the aquifer, especially depth to groundwater and hydraulic conductivity. The intent of proper purging is to stabilize the water level in the well and minimize the hydraulic stress to the hydrogeologic formation. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging completion criteria.

5.0 VOLUME-OF-WATER PURGING TECHNIQUE

5.1 Measuring the purge volume —The volume of water that is removed during purging must be recorded. Therefore, you must measure the volume during the purging operation.

5.2 Collect the water in a graduated container and multiply the number of times the container was emptied by the volume of the container, or

5.3 Estimate the volume based on pumping rate. This technique may be used only if the pumping rate is constant. Determine the pumping rate by measuring the amount of water that is pumped for a fixed period of time or use a flow meter.

1. Calculate the amount of water that is discharged per minute:

$$D = \frac{\text{Measured amount}}{\text{Total time in minutes}}$$

2. Calculate the time needed to purge one (1) well volume or one (1) purging equipment volume:

$$\text{Time} = \frac{V}{D}$$

Where: V = well volume determined, or purging equipment volume
D = discharge rate calculated above

3. Make new measurements each time the pumping rate is changed, or

5.4 Use a totalizing flow meter, and

1. Record the reading on the totalizer prior to purging,
2. Record the reading on the totalizer at the end of purging
3. Subtract the reading on the totalizer prior to purging from the reading on the totalizer at the end of purging to obtain volume purged.

5.5 Record in the field logbook the times that purging begins and ends.

6.0 TUBING AND PUMP PLACEMENT

6.1 Use new or dedicated tubing, where applicable.

6.2 Do not lower the pump or tubing to the bottom of the well. Pump or tubing placement will be determined by the purging option selected (i.e., conventional or minimizing purge volume). If the following conditions can be met for minimizing purge volume, position the intake hose or pump at the midpoint of the screened or open-hole interval:

- The same pump must be used for both purging and sampling,
- The well screen interval must be less than or equal to 10 feet, and
- The well screen must be fully submerged.

6.3 Position the pump or intake in the top one foot of the water column or no deeper than necessary for the type of pump for conventional purging. If the well screen is partially submerged, and the pump will be used for both purging and sampling, position the pump midway between the measured water level and the bottom of the screen.

6.4 Bailers will only be used if specified in a permit or order, if free product is present in the well, or as a last contingency.

6.4.1 Minimize handling the bailer as much as possible, using the lanyard to move and position the bailer.
6.4.2 Lower and retrieve the bailer slowly and smoothly.
6.4.3 Do not lower the top of the bailer more than one foot below the top of the water table so that water is removed from the top of the water column. Ensure that the length of the bailer does not exceed the length of the water column.
6.4.4 Retrieve the bailer and measure and record the purge volume by one of the methods in Section 5.0.
6.4.5 Continue to carefully lower and retrieve the bailer until purge completion conditions have been satisfied.
6.4.6 Remove at least one well volume before collecting measurements of the field parameters. Take each subsequent set of measurements after removing at least ¼ well volume between measurements.

7.0 PARAMETER STABILIZATION TECHNIQUES

Begin to record stabilization measurements after pumping the minimum volume as prescribed below. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

7.1 Conventional purge — For wells with 1) fully submerged screen and pump or intake tubing placed at the top of the water column, 2) partially submerged well screen, or 3) screened interval is unknown, purge a minimum of one well volume prior to collecting measurements of the field parameters. Take measurements of the field parameters no sooner than two to three minutes apart.

7.2 Minimizing purge volume — For wells with fully submerged screen and pump or intake tubing placed within the screened interval, purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one volume of the pump, associated tubing and flow container (if used) prior to collecting measurements of the field parameters. Take measurements of the field parameters no sooner than two to three minutes apart. Purge at least three volumes of the pump, associated tubing and flow container, if used, prior to collecting a sample.

7.3 Purging Completion — The use of a flow-through cell to measure the stabilization parameters using this technique is required. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria. At a minimum, stabilization parameters will include temperature, pH, and specific conductance. Purging is considered complete if three consecutive measurements of the stabilization parameters meet the criteria listed below:

- Temperature: $\pm$ 0.2° C (optional)
- pH: $\pm$ 0.1 Standard Units
- Specific Conductance: $\pm$ 3.0% of reading
- Dissolved Oxygen: $\pm$ 0.3 mg/L or 10%, which ever is greater
- Turbidity: $\pm$ 10% NTUs (>10NTU)

The measurements evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements of temperature, pH and specific conductance cannot exceed the stated limits. The last three consecutive measurements turbidity must all be at or below the listed thresholds.

7.4 If stabilization criteria cannot be met after removing three to five well volumes, collect the sample.

7.5 Document and report the following, as applicable:

- Purging rate,
- Drawdown in the well, if any,
- Total volume purged,
- Pump or tubing intake placement,
- Length and location of the screened interval.

8.0 PURGE DRY WELLS

This criterion applies only if purging was attempted and if it is impossible to balance the pumping rate with the rate of recharge at very low pumping rates (< 100 mL/minute).

8.1 If wells have previously and consistently purged dry, and the current depth to groundwater indicates that the well will purge dry during the current sampling event, minimize the amount of water removed from the well by using the same pump to purge and collect the sample:

1. Place the pump or tubing intake within the well-screened interval.
2. Use very small diameter Teflon, Polyethylene or PP tubing and the smallest possible pump chamber volume to minimize the total volume of water pumped from the well and to reduce drawdown.
3. Select tubing that is thick enough to minimize oxygen transfer through the tubing walls while pumping.
4. Pump at the lowest possible rate (100 mL to 500 mL/minute or less) to reduce drawdown to a minimum.
5. Purge at least two volumes of the pumping system (pump, tubing and flow cell, if used).
6. Measure stabilization parameters begin to collect the samples.

8.2 Collect samples immediately after purging is complete. The time period between completing the purge and sampling cannot exceed 12 hours. If sample collection does not occur within one hour of purging completion, re-measure the field parameters prior to collecting the sample.

9.0 RECORDS

The Field Team Leader (FTL) is responsible for maintaining permanent QC sample records.

9.1 Sample Collection Record
9.2 Daily Log

10.0 REFERENCES

10.1 USEPA Region 4, 1966. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1966.

10.2 Puls, R.W. and M.J. Barcelona, 1996. Groundwater Issue Paper: Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures, USEPA, EPA/540/S-95/504, 12 pp.

10.3 Wilde, F.D., D.B. Radtke, J. Gibs and R.T. Iwastsubo, eds, 1988. National field manual for the collection of water quality data. U.S. Geological Survey Techniques of Water Resources Investigations, Book 9, Handbook for Water-Resources Investigations.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures for measuring field water quality parameters of groundwater samples using a Hydrolab MiniSonde or Datasonde 4a in conjunction with a peristaltic or submersible pump during low-flow purging and sampling. Measurement procedures using a flow-through cell include those for temperature, specific conductance, pH, and dissolved oxygen that closely represent water quality conditions in the aquifer.

2.0 SCOPE

2.1 This SOP shall be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.2 This SOP shall be implemented when collecting groundwater samples using a peristaltic or submersible pump in accordance with a site-specific work plan or sampling and analysis plan.

2.3 Use these SOPs in conjunction with SOP 322:

- SOP 120, *Sample Control and Field Documentation*
- SOP 320, *Groundwater Sampling*
- SOP 321, *Well Purging*

3.0 EQUIPMENT AND MATERIALS

3.1 Hydrolab MiniSonde or DataSonde 4a ("Hydrolab"): The Hydrolab contains probes and related circuitry that collect *in situ* water quality data. Probes discussed in this document include those for temperature, specific conductance, pH, and dissolved oxygen.

3.2 Hydrolab Surveyor 4 ("Surveyor"): The Surveyor is the hand-held user interface connected to the Hydrolab. It contains an LCD data screen and data input and menu navigation buttons.

3.3 Waterproof cable: The Surveyor and Hydrolab are linked via a waterproof cable that connects the serial port on the back of the Surveyor to the 6-prong connector on the end of the Hydrolab.

3.4 Hydrolab calibration cup and cap: The Hydrolab cup threads onto the probe end of the Hydrolab and provides protection for the enclosed probes and a container for calibration solutions. The cap is normally removed to add and pour off

solutions during calibration, but is threaded into the end of the cup for storage and transport.

3.5 Calibration standards: Calibration standards for pH (4, 7, and 10 su) and specific conductance (447 and 1500 µS/cm) will be used to calibrate the Hydrolab.

3.6 Deionized or distilled water and Q-tips: Between calibrations the calibration cup and probes will be rinsed with deionized or distilled water. General cleaning of the hydrolab may be performed using this water and Q-tips.

3.7 NBS traceable thermometer: Because the Hydrolab temperature sensor is factory calibrated, only a temperature check using a thermometer can be performed.

3.8 Instrument Calibration Form (ICF): This form is used to record information related to instrument calibration: type of meter, meter number, calibration parameter, calibration standard value, parameter units, meter reading (of standard prior to calibration), whether or not the meter was calibrated to the standard, and any related comments.

3.9 Hydrolab flow-through cell: The flow-through cell is a lengthened calibration cup with two tubing adapter fittings. It threads onto the probe end of the Hydrolab in the same manner that the calibration cup is attached.

3.10 Miscellaneous tubing and adapters: Various tubing sizes and adapters will be needed to connect the tubing placed in the well with the submersible or peristaltic pump and the Hydrolab flow-through cell.

3.11 Sampling Record Form: As field parameter data is being monitored, *in situ* readings are recorded along with their corresponding times on the Sampling Record Form. Other information to be recorded on the form include site data, water level data, and sample data.

4.0 PROCEDURE

4.1 Calibration

4.1.1 General:

4.1.1.1 Calibrate the Hydrolab before each sampling event.

4.1.1.2 The Hydrolab should be positioned and supported vertically, and all sensors should be cleaned by gently wiping probe surfaces with a Q-tip and deionized or distilled water if needed.

4.1.1.3 Between sensor checks and calibrations, the Hydrolab cup and probes should be rinsed 3 times with tap water, then 3 times with deionized or distilled water.

4.1.1.4 Before each calibration, the cup and probes should be rinsed with the calibration standard to be used, and then the cup should be filled with the calibration solution so that the appropriate probe is completely immersed.

4.1.1.5 Follow these calibration steps using the Surveyor: "Setup/Cal" >> "Calibrate" >> "Sonde" >> Scroll to desired parameter >> "Select" >> Enter calibration standard value >> "Select" >> "Done".

4.1.1.6 When a calibration procedure is completed correctly, the Surveyor will display the message "Calibration Successful!". If the calibration is not completed correctly, the Surveyor will display the message "Calibration Failed!". If calibration attempts repeatedly fail after cleaning probes and using new calibration standard solutions, call Hydrolab technical support at 1-800-949-3766.

4.1.2 Temperature. Hydrolab temperature sensors are factory calibrated, and no temperature calibration is performed. A temperature check is performed by placing an NBS traceable thermometer in the cup with one of the calibrating solutions. The thermometer reading is recorded in the "Standard Value" column of the ICF, and the Hydrolab reading is recorded in the "Meter Reading" column. Indicate on the ICF that the temperature sensor was not calibrated to a standard.

4.1.3 Specific Conductance: Perform an initial specific conductance air calibration by emptying all contents from the calibration cup. The reading on the Surveyor should be "0". Record "0" in both the "Standard Value" and "Meter Reading" columns. If the Surveyor does not display a "0" value, swab the interior of the specific conductance probe, taking care to remove all debris and residue from the contacts on either side of the probe interior. Rinse the probe with deionized water and repeat the check. If the probe again fails to produce a "0" value, record the value in the "Meter

Reading" column and calibrate the reading to "0". Fill the calibration cup with either 447 or 1500 µS/cm, choosing a calibration standard solution appropriate for the expected range of field values. Record the Surveyor value for the desired standard in the "Meter Reading" column and calibrate the Hydrolab if necessary.

4.1.4 pH: Check the pH probe to make sure the bulb and teflon junction are free of residue, and clean if necessary. Fill the calibration cup with a 7 su calibration standard and note the meter reading and calibrate if necessary. Perform a second calibration using either 4 or 10 su, depending upon expected field values.

4.1.5 Dissolved Oxygen: Fill the calibration cup with tap water to just below the O-ring that secures the membrane to the dissolved oxygen sensor. Use a Q-tip to remove moisture from the membrane surface, and make sure there are no bubbles trapped below the membrane within the probe. If bubbles appear below the membrane, probe maintenance will have to be performed. Invert the calibration cup cap and rest it on the top rim of the calibration cup. Record the barometric pressure displayed on the Surveyor in mmHg in the "Comments" column of the ICF. Allow the dissolved oxygen reading to stabilize, then record the value displayed on the Surveyor under the "Meter Reading" column. Calibrate the Hydrolab for "DO % Sat," and input the recorded barometric pressure. After calibration record the new dissolved oxygen reading in the "Standard Value" column of the ICF.

4.2 Operation

4.2.1 Flow-through cell setup. Tubing that is attached to the fitting threaded into the flow-through cell cap brings water pumped from the well into the flow-through cell. The fitting that is attached along the length of the flow-through cell allows water to exit the cell and should be oriented vertically upward so that water exits the flow-through cell only after the cell is completely filled with water. Tubing from the exit fitting should transfer water to a purge water collection container.

4.2.2 Circulator. The Hydrolab circulator should be on so that water flowing through the cell moves evenly around the probes and sediment or debris is cleared from the cell. The circulator is turned on by following the Surveyor prompts: "Setup/Cal" >> "Setup" >> "Sonde" >> "Circltr: Off/On" >> "Select" >> "1" >> "Select" >> "Done". The circulator should then begin to rotate, and the Surveyor should indicate "Setup Successful!".

4.2.3 Pumping rate. Water is pumped through the flow-through cell until parameters stabilize according to SOP 321, *Well Purging*.

5.0 RECORDS

The Field Team Leader (FTL) is responsible for preparing the following records in accordance with SOP 120, *Sample Control and Field Documentation*:

- Instrument Calibration Form
- Sampling Record Form
- Daily Log Form

6.0 REFERENCES

6.1 Hydrolab Corporation, 1997. Datasonde 4 and MiniSonde Water Quality Microprobes User's Manual, Revision D.

6.2 Hydrolab Corporation, 2002. Hydrolab Water Quality Monitoring Instrumentation Training Seminar Handbook.

1.0 PURPOSE

This Standard Operating Procedure (SOP) presents the procedures to be used to consistently collect representative surface water samples for site assessments. Each collection event must be performed, so samples are neither contaminated nor altered from improper handling.

2.0 GENERAL

2.1 This SOP shall be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.2 This SOP covers general surface water sampling for chemical analyses. Sampling locations, types, and analytical parameters, and other requirements are specified in site-specific sampling and analysis plans (SAPs).

2.3 There are several methods for collecting surface water samples. The Field Team Leader (FTL) shall have the flexibility to decide which one of the methods in Section 4.0 is most appropriate based on conditions at the time of sampling.

2.4 When using watercraft, take samples near the bow, away and upwind from any gasoline outboard engine. Orient watercraft so that bow is positioned in the upstream direction.

2.5 When wading, collect samples upstream from the body.

2.6 Avoid disturbing sediments in immediate area of sample collection. Collect water samples prior to taking sediment samples when obtaining both from the same site.

2.7 Collect surface water samples from downstream towards upstream.

3.0 EQUIPMENT AND MATERIALS

3.1 Use sampling equipment constructed of materials consistent with the analytes of interest.

3.2 Refer to the site-specific work plan for information on sample container size and construction, and preservation and holding time requirements.

3.3 For information on sampling equipment cleaning requirements see SOP 130, *Decontamination of Drilling and Sampling Equipment*.

3.4 For information on documentation requirements, see SOP 120, *Sample Control and Field Documentation*.

3.5 Other equipment and materials may include water quality meters, disposable gloves, wooden stakes and flagging, boots, waders, and pH paper.

4.0 SAMPLING METHODS

4.1 One method for collecting a surface water sample is to use a peristaltic pump. The pump system allows the use of a filtration assembly with the pump and sample container. With this method, surface samples are filtered if needed, and collected directly with minimal elapsed time. The acceptable tubing is medical grade silicon, which is decontaminated or replaced after every sample (Ref. 7.1).

4.2 An alternative method is to collect surface water as grab samples. Samples can be collected using a transfer device constructed of polyethylene Teflon^{TM}, stainless steel, or glass. The transfer device is used to transfer liquid wastes from surface waters to a sample container. Field personnel must avoid using metal transfer devices for trace-metal analysis or plastic devices for sampling trace organics.

4.3 The water sample can be collected directly by dipping the sample container into the water and filling, removing, and capping it. This direct grab method requires the exterior of the sample container to be rinsed after collection to avoid spreading possible contamination.

4.4 Examples of equipment that may be used for depth grab sampling include Kemmerer, Niskin, Van Dorn, double check-valve bailers, and similar samplers

4.5 Samples may be collected using automated samplers. There are many types of automatic samplers. Follow manufacturer's instructions when using an automated sampler.

5.0 PROCEDURE

5.1 The Field Team Leader (FTL) shall monitor the implementation of these procedures, document procedure deviations (SOP 120), and refer to the site work plan, sampling plan or other appropriate plan to locate sampling sites along the surface water body.

5.2 The FTL shall insure that field instruments are properly calibrated and records of calibration are maintained (SOP 120)

5.3 The FTL or field team member shall decontaminate all sampling equipment before taking the first sample and between sampling locations (SOP 130).

5.4 The FTL or field team member should place a reference marker that includes the location identification number as close to the sampling location as possible for survey purposes, or collect and record GPS coordinates.

5.5 The FTL or field team member should verify sample containers and preservatives for the appropriate size and type of sample

5.6 If the FTL or field team member collects samples with direct grab method, follow the procedure outlined below:

1. Collect surface grab samples within the top 12 inches of the water column. Avoid skimming the surface of the water during collection unless specifically required by the sampling plan.

2. Where practical, use the actual, unpreserved sample container as the collection device (direct grab).

3. Slowly remove the container cap and slowly submerge the container, opening first, into the water.

4. Invert the bottle so the opening is upright and pointing towards the direction of water flow (if applicable). Allow water to run slowly into the container until filled.

5. Return the filled container quickly to the surface.

6. Pour out a small volume of sample away from and down stream of the sampling location. This procedure allows for addition of preservatives. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

7. Add preservatives, if required, securely cap container, label, and complete field notes.

8. If preservatives have been added, invert the container several times to ensure sufficient mixing of sample and preservatives.

9. Check preservation of the sample and adjust pH with additional preservative, if necessary.

5.7 If the laboratory provides pre-preserved sample containers, use an intermediate vessel or container to collect samples following the procedure outlined below:

1. Rinse the intermediate vessel/transfer with ample amounts of site water prior to collecting the first sample. Discard rinsate away from or downstream of the sampling location.

2. After adequate rinsing, fill the intermediate vessel with sample water, as described in Section 5.6 above. Minimize agitation of the sample.

3. Fill sample containers from the transfer vessel. Minimize agitation during filling. Do not touch the sample container with the transfer vessel.

4. Leave adequate headspace in the sample container. This procedure allows for addition of preservative (if required). Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

5. Add preservatives if required, securely cap container, label and complete field notes.

6. Invert the container several times to ensure sufficient mixing of sample and preservatives.

7. Check preservation of the sample and adjust the pH with additional preservative, if necessary.

5.8 If the FTL or field team member collects samples with a peristaltic pump, follow the procedure outlined below:

1. Install clean peristaltic pump tubing according to manufacturer's instructions.

2. Place intake end of the tubing into the water to a depth 6-12 inches below the water surface, where possible and turn on the pump.

3. Pump several tubing volumes through the system to flush the tubing prior to collecting the first sample.

4. Fill individual sample bottles via the discharge tubing being careful not to remove the inlet tubing from the water.

5. Do not touch the discharge tubing to the sample container.

6. Leave adequate headspace in the sample container. This procedure allows for addition of preservatives (if required). Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

7. Add preservatives if required, securely cap container, label and complete field notes.

8. Invert the container several times to ensure sufficient mixing of sample and preservatives.

5.9 If the FTL or field team member collects samples with a depth grab sampler, follow the procedure outlined below:

1. Many of these samplers are constructed of plastic and rubber that preclude their use for all volatile and extractable organic sampling. Some newer devices are constructed of stainless steel or are all Teflon or Teflon-coated. These are acceptable for all analyte groups without restriction.

2. Measure the water column to determine maximum depth and sampling depth prior to lowering the sampling device.

3. Mark the line attached to the sampler with depth increments so that the sampling depth can be accurately recorded.

4. Lower the sampler slowly to the appropriate sampling depth, taking care not to disturb the sediments.

5. At the desired depth, send the messenger weight down to trip the closure mechanism.

6. Retrieve the sampler slowly

7. Rinse the sampling device with ample amounts of site water prior to collecting the first sample. Discard rinsate away from and downstream of the sampling location.

8. Fill the individual sample bottles via the discharge tube and handle as described above.

5.10 Collect samples using double check-valve bailers if the data requirements do not necessitate a sample from a strictly discrete interval of the water column. Bailers with an upper and lower check valve can be lowered through the water column and water will continually be displaced through the bailer until the desired depth is reached, at which point the bailer is retrieved.

1. Sampling with this type of bailer must follow the same protocols outlined in Section 5.9 above except that a messenger weight is not applicable.

2. Although not designed specifically for this kind of sampling, a bailer is acceptable when a mid-depth sample is required.

3. As the bailer is dropped through the water column, water is displaced through the body of the bailer. The degree of displacement depends upon the check-valve ball movement to allow water to flow freely through the bailer body.

4. Slowly lower the bailer to the appropriate depth. Upon retrieval, the two check-valves seat, preventing water from escaping or entering the bailer.

5. Rinse the sampling device with ample amounts of site water prior to collecting the first sample.

6. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described in previous sections of this SOP.

5.10 Automatic samplers are used when sites are to be sampled at frequent intervals or when a continuous sample is required. Automatic samplers are frequently used in situations where sampling equipment is deployed on site for a long term. This situation is not anticipated for most site assessment work, therefore, procedures for using automatic samplers are beyond the scope of the SOP.

6.0 RECORDS

The Field Team Leader (FTL) is responsible for maintaining permanent QC sample records.

6.1 Sample Collection Record
6.3 Daily Log
6.4 Chain-of-Custody documentation

7.0 REFERENCES

7.1 EPA Region 4, 1996. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, May 1996.

GENERAL DRILLING OPERATIONS IN UNCONSOLIDATED MATERIALS USING A HOLLOW STEM AUGER (HSA) OR DIRECT PUSH TECHNOLOGY (DPT)

SOP 410

1.0 PURPOSE

This Standard Operating Procedure (SOP) specifies methods for drilling operations using a hollow stem auger (HSA) or Direct Push Technology (DPT) for subsurface investigations.

2.0 SCOPE

2.1 This SOP shall be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.2 This SOP covers general drilling operations, lithologic logging, and borehole abandonment. Specifics of the investigation, including drilling and sampling locations, investigation depths, sampling and testing, and any special requirements will be specified in the site-specific work plan or sampling and analysis plan (SAP). Specialized sampling may require modification of these procedures beyond the scope of this SOP.

2.3 Use the following SOPs in conjunction with SOP 410:

- SOP 130, *Decontamination of Drilling and Sampling Equipment*
- SOP 140, *Management of Investigation-Derived Wastes*
- SOP 310, *Soil Sampling*
- SOP 510, *Monitoring Well Construction*

3.0 EQUIPMENT AND MATERIALS

Descriptions of commonly used pieces of equipment are listed below and are typically provided by the subcontractor.

3.1 HSA rig and tools capable of drilling and sampling to the desired depth and equipped with split spoons, Shelby tubes, or continuous samplers.
3.2 DPT rig and drill rods capable of pushing sampler to desired depth.
3.3 Potable water and decontamination equipment
3.4 Plug and abandonment supplies and equipment (bentonite, grout, grout pump or mixer, etc.)
3.5 Waste containers
3.6 Equipment and supplies for temporary decontamination pad
3.7 5-ft, 1-inch or 2-inch diameter PVC screens and risers for installation of temporary well completions (if applicable)
3.8 Personal protective equipment
3.9 Equipment for stratigraphic logging
3.10 Field logbook

3.11 Photoionization Detector (if applicable)
3.12 Personal protective clothing and equipment

4.0 GENERAL PROCEDURES

4.1 Confirm that sampling locations are marked and that clearances from all utilities have been obtained.

4.2 Verify that the drilling subcontractor has the necessary tools and equipment to complete the job.

4.3 Conduct a safety meeting at the beginning of the work and have all site personnel sign the tailgate safety meeting form. Conduct brief tailgate safety meetings at the beginning of each day.

4.4 Drill crews shall assemble a decontamination pad, set up equipment, and decontaminated drilling and sampling equipment.

4.5 Position the HSA or DPT rig over the sampling location. If the sample location is on asphalt or concrete, it may be necessary to use a hammer drill, concrete corer, or equivalent to drill a hole through the pavement. As drilling progresses, berms should be used around the borehole to prevent migration of surface contaminants into the borehole, if needed.

4.6 Collect soil samples as specified in the site-specific SAP and SOP 310, *Soil Sampling*.

4.7 If groundwater sampling using DPT, advance tubing with a screened end into the borehole below the water table and use a peristaltic pump to collect a grab sample. If groundwater recharge is too slow to allow for efficient sampling, temporary wells may be installed in borings following procedures in SOP 510, *Monitoring Well Construction*.

4.8 After the borehole has been completed to the desired depth and if no temporary well completions have been specified, abandon the borehole, as follows:

4.8.1 For boreholes drilled with HSA drilling methods, seal the borehole by using a Portland cement/bentonite grout. Grout must contain not less than 5% powdered bentonite by weight, with wet grout weight not less than 95 pounds per cubic foot. Admixtures, which retard or accelerate the set, shall not be used.

4.8.2 Pump (if >10 ft) or pour grout through a tremie pipe.

4.8.3 Slowly remove augers from boreholes as grout is placed to the bottom of the borehole through the augers until undiluted grout flows near to the surface in paved areas and at ground surface otherwise. In formations where the borehole stays open without augers in place, grout may be added after the augers have been removed.

4.9 Abandon DPT probe holes as appropriate for the location. Often times this involves backfilling with bentonite chips.

4.10 Collect and manage all wastes as specified in SOP 140, *Management of Investigation-Derived Wastes*.

4.11 Patch the pavement with an appropriate material similar to surrounding materials.

4.12 The abandonment procedures for temporary cased borings will be the same as that for boreholes; however, the initial step will be to completely remove the casing and annulus materials from the boring.

4.13 Mark boring locations with a clearly labeled state, pin flag, or spray paint that indicates the site and borehole number.

5.0 RECORDS

The Field Geologist is responsible for logging boreholes and classifying soils in accordance with ASTM D2488 and the Unified Soil Classification System. Lithologic logging will be recorded on borings logs (Attachment A). For consistency, all descriptions should use the following order and style:

- Formation name (if known),
- USCS code,
- Soil type, including secondary components (silty CLAY),
- Soil color,
- Consistency for cohesive soils; density for non-cohesive soil,
- Plasticity for fine grain clay and silt (non-plastic, low, medium, high),
- Sorting and grain size for sands and gravel,
- Structure (homogeneous, stratified or laminated, blocky, fissured)
- Miscellaneous descriptors (roots, nodules, odors, particle angularity)
- Relative moisture content (dry, moist, wet),
- HCL reaction, if any (weak, strong).

6.0 ATTACHMENTS

Attachment A: Example boring log

7.0 REFERENCES

7.1 ASTM D6151 Standard Practice for Using Hollow-Stem Augers for Geotechnical Exploration and Soil Sampling.

7.2 ASTM D2488 Standard Practice for the Description and Identification of Soil (Visual-Manual Procedure).

7.3 EPA, 1991. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. Environmental Monitoring System Laboratory, Office of Research and Development.

7.4 EPA, 1986. RCRA Ground Water Monitoring Technical Enforcement Guidance Document, OSWER, Washington D.C.

ftn Associates Ltd. water resources / environmental consultants	PROJECT:	BORING ID:	
	LOCATION:	WELL ID:	
	DRILLING CONTRACTOR:	NORTHING:	EASTING:
	DRILLING EQUIPMENT:	GROUND SURFACE ELEV.:	TOC ELEVATION:
	DRILLING METHOD:	TOTAL DEPTH:	DEPTH TO WATER:
LOGGED BY:	SAMPLING METHOD:	DATE STARTED:	DATE COMPLETED:

Depth (feet)	USCS	Graphic Log	Description	% REC	# Blows	Well Construction
-5						
0						
5						
10						
15						
20						
25						
30						
35						
40						
45						
50						
55						
60						
65						
70						
75						
80						
85						
90						
95						

NOTES:

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process of monitoring well construction for site assessments and groundwater monitoring programs.

2.0 SCOPE

2.1 Subcontractors performing work under FTN's quality assurance program shall follow this SOP for constructing and developing wells or may use their own procedure(s) as long as the substitute meets requirements prescribed by the Quality Assurance Project Plan (QAPP).

2.2 This SOP will be used in conjunction with the site-specific health and safety plan (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.3 Installation of monitoring wells will be conducted in accordance with applicable state and federal regulations.

2.4 This SOP is for the construction of typical monitoring wells in the region. Monitoring well locations, total depth, and construction details shall be specified in a site-specific work plan or sampling and analysis plan (SAP). Any special construction requirements will be specified in the site-specific SAP.

2.5 Use the following SOPs in conjunction with SOP 510:

- SOP 120, *Sample Control and Field Documentation*
- SOP 130, *Decontamination of Drilling and Sampling Equipment*
- SOP 140, *Management of Investigation-Derived Wastes*
- SOP 410, *General Drilling Operations in Unconsolidated Materials Using a Hollow Stem Auger (HSA) or Direct Push Technology (DPT*).

3.0 EQUIPMENT AND MATERIALS

Descriptions of commonly used pieces of equipment are listed below.

3.1 Well construction supplies (some of these items are suggestions only, and the list is not all-inclusive).

- Silica sand (i.e., 10/20, 20/40 etc. grain size, as required)
- Cement — Type I Portland
- Potable water supply
- Schedule 40 PVC well casing (in most circumstances), pre-sized well screen, cap, and bottom plug for each well, as required (typically 2-inch diameter although 4-inch is sometimes used; ¾-inch and 1-inch are frequently used for temporary wells).
- Casing centralizers, if required

- Bentonite pellets, bentonite powder, or bentonite grout
- Protective steel casing or manhole assembly, depending on requirements
- Guard posts for above-grade completions
- Locking caps and padlocks

3.2 Well Construction Equipment

- Drill rig and accompanying equipment (augers, drill rods, casing, samplers, etc)
- Tremie pipe
- Grout-mixing and pumping unit
- Steam cleaner
- PPE and disposable gloves

4.0 PROCEDURE

4.1 Drill the borehole

4.1.1 Advance the boring to completion depth as specified in the SAP and conduct soil sampling, if required.

4.1.2 The minimum annular distance between well screen/casing and the borehole wall shall be 2 inches.

4.1.3 Measure total depth of borehole relative to ground surface with a weighted tape.

4.1.4 Pre-develop borehole by circulating drilling fluids (water or air) or by rotating augers until hole is cleaned of cuttings, where practical. Remove cuttings from the area around the auger and transfer to a drum.

4.1.5 Withdraw drill rods and bit/auger flights. If installing well casing through hollow-stem augers (HSA), leave the augers in the hole during filter pack placement and bentonite seal placement to the extent practical. Maintain sand/bentonite in the casing a small distance (1 to 2 ft) above the bottom of the auger for even placement, as the augers are removed. Special attention should be given to the amount of fill material if this procedure is followed due to the risk of bridging in saturated conditions.

4.1.6 Place a cap over the top of the well casing before placing annular backfill materials.

4.1.7 Any use of solvents and glues is prohibited.

4.2 Wearing disposable gloves, assemble pre-cleaned screen/casing string, lower to the bottom of the borehole, and center casing in place.

4.3 Filter pack helps ensure continuous flow capability from the natural formation into the well bore. The following is a list of instructions for using a sand pack

4.3.1 Use well-sorted and rounded sand that is clean, inert, siliceous and compatible with the screen slot size in use.

4.3.2 Record the filter-pack size, the company from which it was purchased, and the lot number (if available) for each installation. Pint-size samples of filter-pack material may be collected for quality control.

4.3.3 Fill the annulus between the well screen and borehole wall with silica sand to a height of 2 feet above the screened interval. For wells greater than 30 ft in depth, a tremie pipe will be used to place the materials.

4.3.4 Ascertain the depth of the top of the sand with a weighted tape and verify the thickness of the sand pack. Add additional sand, if necessary, to bring the top of the sand pack to the proper elevation, and repeat the measurement.

4.3.5 Under no circumstances should the sand pack extend into any aquifer other than the one to be monitored. In most cases, the well design can be modified to allow for a sufficient sand pack without the threat of cross flow between producing zones.

4.3.6 In the event that a predominantly fine-grained, water-bearing unit is encountered, it may be desirable to construct a monitor well that uses a factory-manufactured screen and filter prepack assembly. Various sand-pack gradations are available. The prepacked screen assembly is attached to the solid well casing (riser) in the same manner as a conventional screen. The fine-grained formation materials are allowed to collapse against the repacked well screen. Prepacked well screen have larger OD'' which must be considered when calculating backfill.

4.4 Bentonite Seal — Use bentonite chips, pellets, or crushed or granular bentonite. Pellets should have a minimum purity of 90% montmorillonite clay and a minimum dry bulk density of 75 lb/ft^3.

4.4.1 Pour the bentonite directly down the annulus. Pour the pellets from different points around the casing to ensure an even application. A tremie pipe may be used to redistribute and level the top of the seal.

4.4.2 Fill the annulus between the well casing and borehole above the filter pack with a bentonite seal at least 2 ft thick.

4.4.3 If the seal is above the water table, hydrate according to manufacturer's specifications or 12 hours, which ever is greater, using deionized water.

4.4.4 For wells deeper than 30 ft, bentonite backfill material can be pumped or poured through a tremie pipe.

4.4.5 Measure the distance to the top of the seal with a weighted tape to verify that the proper thickness of the seal has been placed in the annulus.

4.4.6 Repeat application and verification, as needed.

4.5 Annular Well Seal

4.5.1 If a cement-grout annular seal is to be installed, use Portland cement. The grout must be mixed thoroughly with 2% to 5% bentonite powder to produce a nonshrinking seal. Mix solid with water (approximately 6 gallons to each 94 lb-bag of cement) to make pumpable slurry.

4.5.2 Pour or pump grout into the annulus through a tremie pipe. Slowly withdraw the auger as the annulus fills. Below a depth of 10 ft, grout must be pumped to the bottom of the open annulus until undiluted grout flows from the annulus at the ground surface. Grout may be poured directly into the annulus if it is dry and the top of the bentonite seal is readily visible (generally 5 ft or less).

4.5.3 After the grout has set (about 24 hours), fill any depression in the grout caused by settlement with a grout mix similar to that previously described.

4.5.4 Grout will be allowed to cure at least 24 hours before beginning well development.

4.5.5 For temporary well completions, bentonite is used as an annular seal.

4.6 Well Pad

4.6.1 Cut riser to appropriate height depending on type of completion —above grade (1.5 to 3 ft above ground surface) and flush-mount. If above grade completion, vent well by cutting a horizontal slit in the riser an inch below the bottom of the inserted well cap and install the protective steel casing with locking cap and grout it in place. The slit for the vent should not exceed ½-inch in length on the PVC inside diameter and should be no wider than a typical handsaw cut. Drill a small drain hole (approximately

¼-inch diameter) in the steel casing six inches below the level of the vent in the riser.

4.6.2 Use identification plates, paint, or waterproof markers to denote the monitoring well identification number on the steel protective casing or under the manhole cover.

4.6.3 Form and pour the concrete protective pad around the protective casing or manhole assembly. The concrete pad should be sloped away from the casing for positive drainage. Pad dimensions will not be less than 2 ft x 2ft x 0.5 ft.

4.6.4 The installation of guard posts is recommended in areas where vehicle traffic might pose a hazard to above-grade completions. Four guard posts (minimum 3 inches in diameter) are radially located around each well and placed at least 2 ft below ground surface. Each post will have a minimum of 4 ft above ground surface, and in cases where the well is surrounded by high vegetation, will have a flagged attached for greater visibility. Each post should be cemented inside of a hole that has a minimum diameter of 6 inches. Guard posts are typically painted with high-visibility epoxy paint.

4.6.5 Well pads are not constructed for temporary wells, unless the temporary wells will be used for a period exceeding one month.

5.0 RECORDS

The Field Geologist is responsible for maintaining permanent QC sample records.

5.1 Record appropriate construction/completion information in the field logbook and or appropriate field log form.

5.2 Complete the Daily Log, which at a minimum should include:

- All observations made during backfilling and depth sounding in the field logbook.
- Lengths of casing material used and quantities of backfill material used
- An evaluation of any problems encountered and the final resolutions, and
- Any other information or observations that may be useful in assessing the well completion.

6.0 POST-OPERATIONS ACTIVITIES

Ensure that well surveying according to SOP 210, *Location Surveys*, for horizontal control and datum determination are completed, and that the necessary information is entered on the well completion record (Attachment A).

7.0 ATTACHMENTS

Attachment A: Well Completion Record

8.0 REFERENCES

8.1 EPA, 1991. Handbook of Suggested Practices for the Design and Installation of Ground-water Monitoring Wells. Environmental Monitoring System Laboratory, Office of Research and Development.

8.2 EPA, 1986. RCEA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER, Washington D.C. EPA-530SW86055.

MONITORING WELL INSTALLATION RECORD

Job Name _____ Well Number _____

Job Number _____ Installation Date _____ Location _____

Datum Elevation _____ Surface Elevation _____

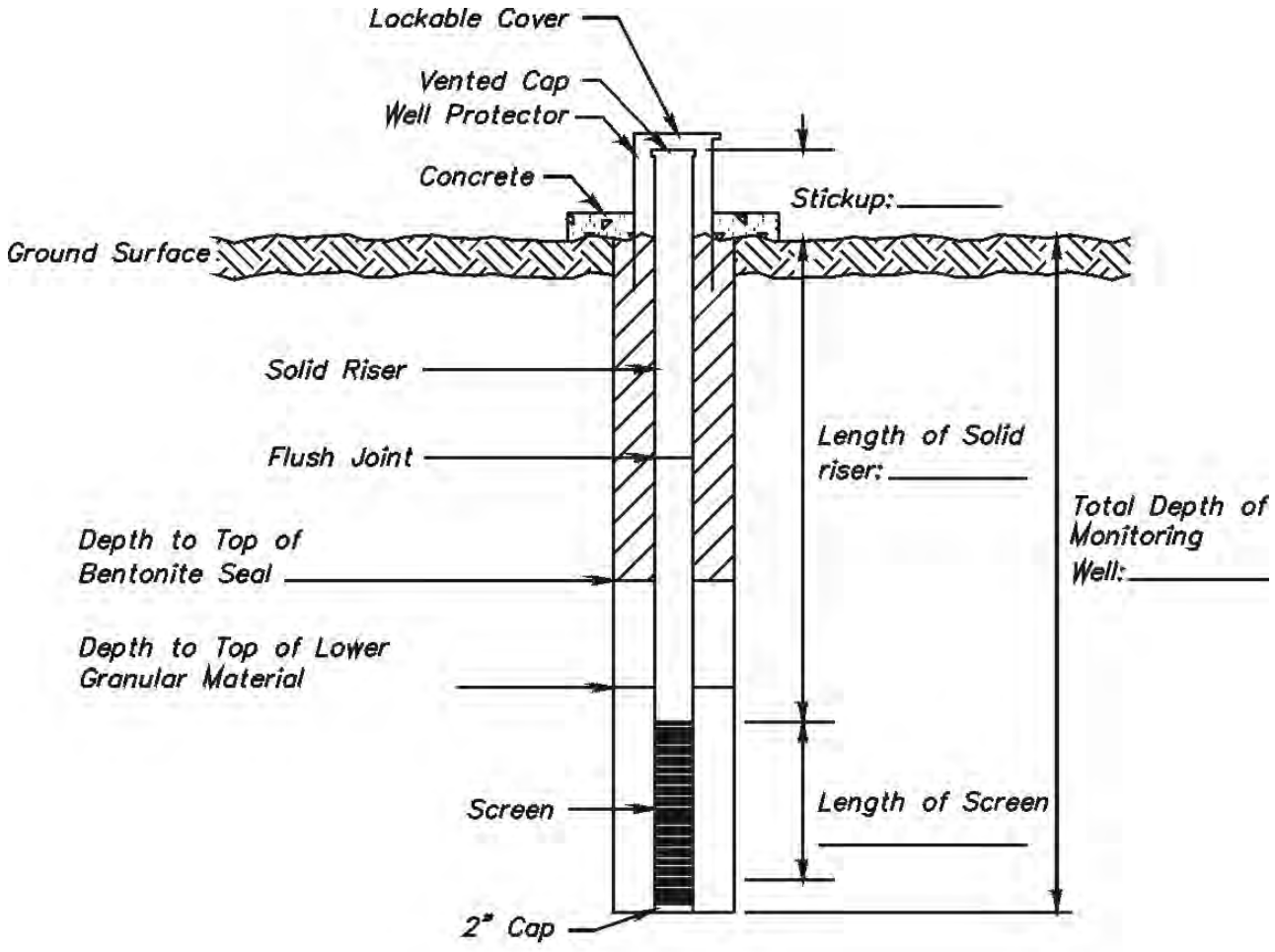
Datum for Water Level Measurement _____

Screen Diameter & Material _____ Slot Size _____

Riser Diameter & Material _____ Borehole Diameter _____

Filter Pack _____ FTN Representative _____

Drilling Method _____ Drilling Contractor _____



ftn Associates Ltd.
water resources / environmental consultants

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures for the development of monitoring wells subsequent to drilling and installation. Procedures are performed to 1) repair damage to the formation caused by drilling activities and 2) increase the permeability of the materials surrounding the well screen. Development procedures serve to remove foreign materials from the groundwater, well annulus, or well screen after well installation, and to facilitate hydraulic communication between the formation and the well screen.

2.0 SCOPE

2.1 This SOP will be used in conjunction with the site-specific health and safety plan (HAS) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.2 This SOP is for well development by means of surging and pumping with a submersible pump and/or bailer. The bailing method is also used as an alternative when the formation or water-producing zone fails to supply water at sufficient rates to sustain development by pumping.

2.3 Use the following SOPs in conjunction with SOP 510:

- SOP 120, *Sample Control and Field Documentation*
- SOP 130, *Decontamination of Drilling and Sampling Equipment*
- SOP 140, *Management of Investigation-Derived Wastes*
- SOP 610, *Water Level Measurements*

3.0 EQUIPMENT AND MATERIALS

- Water level meter
- Plastic sheet
- Submersible pump or bailer
- Well completion information
- Personal protective equipment required in the site-specific HASP
- Turbidity meter
- Photoionization detector (if required)
- 55-gallon drums

4.0 PROCEDURE

4.1 Pre-operation Activities

4.1.1 Coordinate efforts for onsite staging of water that is produced during development. Assemble containers for temporary water storage. Clearly label containers according to SOP 140, *Management of Investigation-Derived Wastes*.

4.1.2 Decontaminate all equipment that will enter the well or come in contact with the development water before developing each well according to SOP 130, *Decontamination of Drilling and Sampling Equipment*.

4.1.3 Assemble equipment on a plastic sheet in an area that is beyond the range of splashing development water activities.

4.1.4 Cover the ground around the well with clean plastic sheeting to contain any spilled development water.

4.1.1 Well development may begin as soon as practical after the well is installed, but no sooner than 24 hours after grouting is completed.

4.2 Open the protective casing and remove the well cap (if applicable). Monitor air quality at the top of the casing and in the breathing zone using a PID (if applicable).

4.3 Measure and record depth to water and the total depth of the well according to SOP 610, *Water Level Measurements*.

4.4 Insert submersible pump into the well and turn on the pump. The pump discharges fine particulate material that moves into the well. Raise and lower the pump within the screened interval. Bailing may be combined with pumping for the most efficient well development.

4.5 Note and record the volumes of water produced as pumping/bailing proceeds.

4.6 Note the initial color, clarity, and any obvious odor of the water.

4.7 Well development shall continue until the water removed is visible free of silt and sand and turbidity readings stabilize at levels of less that 10 NTU or cannot be improved.

4.8 If turbidity levels cannot be improved, purge a minimum of five casing volumes of water before stopping well development.

4.9 If it is determined that the criteria for well development can not be met regardless of the amount of pumping, consult an FTN Senior Hydrogeologist to evaluate alternative procedures, as appropriate.

5.0 RECORDS

The Field Geologist is responsible for maintaining permanent QC sample records. Record measured data and observations in the project field notebook.

6.0 REFERENCES

6.1 EPA, 1991. Handbook of Suggested Practices for the Design and Installation of Ground-water Monitoring Wells. Environmental Monitoring System Laboratory, Office of Research and Development.

6.2 EPA, 1986. RCRA Ground Water Monitoring Technical Enforcement Guidance Document, OSWER, Washington D.C.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the method for determining the depth to groundwater in an open borehole, cased monitor well, or piezometers.

2.0 SCOPE AND COMMENTS

2.1 Water-level measurements are generally used to construct potentiometric surface maps. Water level data are also used to determine groundwater flow direction, hydraulic gradients, and impacts due to pumping or other aquifer stresses, and are used in the calculation of flow velocity.

2.2 This SOP shall be used in conjunction with site-specific health and safety plans (HASP) to help ensure that personnel performing the work are protected from equipment-related accidents and from exposure to hazardous constituents.

2.3 This SOP covers general groundwater level measurements. Refer to the site-specific work plan for more information on the scope of work activities, equipment, and frequency of measurements.

2.4 Water-level measurements across an area should be obtained in less than a 24-hour period or within as short a period of time as possible. Under some conditions all measurements must be taken within a shorter time interval or simultaneously. The follow conditions require measurements to be taken within a shorter time period:

1. If the saturated zone is stressed by intermittent pumping of production wells.
2. If the saturated zone is affected by water levels in a nearby river, impoundment, or unlined ditch.
3. If the saturated zone is being actively recharged because of a precipitation event.
4. If drastic atmospheric pressure changes occur within a monitoring period.

2.5 Allow water levels in piezometers and monitoring wells to stabilize for a minimum of 24 hours after well construction and development before measurements are taken. Repeat measurements periodically to determine if a static water level has been achieved. Recovery may take longer in wells completed in tight formations.

3.0 EQUIPMENT AND MATERIALS

The device used to measure water levels should be adequate to attain an accuracy of 0.01 ft. Generally acceptable devices are listed below.

3.1 Electric water-level meter — A flat graduated tape attached to a stainless steel probe containing an electrode, which emits an audible and visible signal when contact with water is made. This is the most common and preferred manual device.

3.2 Pressure Transducer — An electronic probe connected to a wire cable that is lowered into the water column of a well to measure pressure. The pressure measured in the total pressure, which includes both the hydrostatic pressure of the fluid column above the transducer and the atmospheric pressure at the fluid surface. Changes in head are proportional to changes in the height of the water column or water level. Pressure transducers are designed to be used with electronic data-logging instruments and send a current to the data logger. The current is proportional to the pressure and can be converted to meaningful units by the data logger.

3.3 Steel tape and chalk — This equipment includes a graduated steel tape with a weight attached to its end used to measure depth to water. The graduations on the end of the tape are coated with chalk and the tape is lowered into the well until the lower part of the tape is submerged in water. The total tape in the well is noted and the tape is withdrawn. The change in color of the chalk coating indicates the position of the water surface. The length of wet tape is subtracted from the total tape length to determine depth to water.

4.0 PROCEDURE (USING ELECTRIC WATER-LEVEL METER)

4.1 Calibrate and check equipment prior to leaving for the field.

4.2 Review prior site data to develop an understanding of trends. It is prudent to start measuring with those wells that are least contaminated and proceed towards wells having increasing levels of contamination.

4.3 Make sure reference points have been adequately surveyed and marked. If no reference point is found, measure relative to the top of the inner casing on the north side, then mark that reference point and note the location in the field logbook.

4.4 Upon approaching the first well, unlock the well cap. Note the well ID, date and time of day on the Sampling Record according to SOP 120, *Sample Control and Field Documentation*, or Water Level Elevation Data Sheet (Attachment A). Check for well damage that could indicate a shift in reference point. Note and record in the field logbook any physical changes (like erosion or cracks) in the protective concrete pad or variation in the total depth of the well Check to determine if well is properly vented; if not, remove well cap and allow the well to equilibrate to atmospheric pressure. Note in the field logbook that a vent hole

should be drilled or notched in the well casing, if applicable, before the next round of water level measurements is conducted.

4.5 If required by site-specific conditions, monitor the headspace of the well with a photoionization detector (PID) to determine the presence of volatile organic compounds and record the measurements in the field logbook.

4.6 Lower an electric water-level meter or equivalent into the well until the water surface is encountered.

4.7 Measure the depth to water (DTW), defined as the distance from the water surface to the measuring point, and record the reading. Make at least two, preferably three measurements at each well and average data.

4.8 Where not obstructed by a pump, the total depth of the well should be measured and recorded to the nearest 0.1 ft. Use the DTW and total depth of the monitoring well to calculate the volume of water in the well (i.e. one casing volume) and record on the sampling form, if the well is to be purged for sampling.

4.9 Reel in the water-level meter tape and remove it from the well. Replace the well cap and secure the lock.

4.10 Decontaminate equipment in accordance with SOP 130, *Decontamination of Drilling and Sampling Equipment*, after each measurement, and store it appropriately for transport to the next well site.

4.11 Make measurements at a set of wells in as short a time frame as possible.

4.12 Complete all appropriate data forms and sign all pages.

5.0 RECORDS

The Field Team Leader (FTL) is responsible for maintaining permanent QC sample records.

5.1 Sample Collection Record, or
5.2 Water Level Elevation Data Sheet

6.0 ATTACHMENTS

Attachment A: Water-Level Elevation Data Sheet and Completion Instructions

7.0 REFERENCES

7.1 ASTM. 2002. Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well); ASTM D4750, ASTM, Philadelphia, PA.

Water Level Elevation Data Sheet

Field Area:	Measured By:	Signature:	Page ___ of ___

Well ID	Date	Time	MPD	MPE (ft above msl)	DTW (ft)	WLE (ft above msl)	LMPGS (ft)	DTW/BGS (ft)	Comments

MPD: Measuring Point Description
MPE: Measuring Point Elevation
DTW: Depth to Water
WLE: Water Level Elevation
LMPGS: Length of Measuring Point to Ground Surface
DTWBGS: Depth to Water/BGS

APPENDIX B

Site Safety Plan

SITE SAFETY PLAN
CLOSURE AND POST-CLOSURE ACTIVITIES
NORTHWEST ARKANSAS WASTE MANAGEMENT, INC. ("PARSONS")
CLASS 1 LANDFILL
PERMIT NO. 0205-SR-2
AFIN: 72-00171

DRAFT
APRIL 22, 2008

SITE SAFETY PLAN
CLOSURE AND POST-CLOSURE ACTIVITIES
NORTHWEST ARKANSAS WASTE MANAGEMENT, INC. ("PARSONS")
CLASS 1 LANDFILL
PERMIT NO. 0205-SR-2
AFIN: 72-00171

For site work at:

Northwest Arkansas
Waste Management, Inc. ("Parsons")
Class 1 Landfill
Permit No.: 0205-SR-2
AFIN: 72-00171

Prepared by

FTN Associates, Ltd.
3 Innwood Circle, Suite 220
Little Rock, AR 72211

FTN No. 3013-202

DRAFT
April 22, 2008

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ATTACHMENT 2: Scope of Work Activities
ATTACHMENT 3: Site Safety Plan Amendment Sheet
ATTACHMENT 4: Route to Northwest Medical Center in Springdale, Arkansas
ATTACHMENT 5 Accident Report Form

1.0 HEALTH AND SAFETY PROGRAM

1.1 Purpose

FTN Associates, Ltd. (FTN) project personnel and subcontractor(s) will comply with rules, regulations, and standards pertaining to occupational safety and health and are required to adhere to this Site Safety Plan (SSP). The purpose of this SSP is to outline the precautions that will be taken to minimize potential exposures, accidents, and physical injuries that may occur during onsite activities and adverse conditions and to ensure the wellbeing of field personnel, official visitors, and the community surrounding the site. The SSP provides procedures for preventing, responding to, and reporting injuries, illnesses, and environmental emergency situations. This SSP must be modified or amended when circumstances or conditions develop that are beyond the scope of routine operations for the tasks described in Attachment 2 or as additional information about the site becomes available. Changes in project work scope and/or site conditions as described must be amended in writing by the Project Manager on the Amendment Sheet (Attachment 3). This SSP complies with Title 29 Code of Federal Regulations (CFR) Part 1910.120(b).

1.2 Personnel Briefings

FTN employees and subcontractor(s) will be informed of the provisions of this SSP. Briefings will be conducted prior to initial entry to the project area and at other times as required by the Client. The SSP will be available onsite to field personnel, who will acknowledge having read the SSP and confirm that they are familiar with, and agree to abide by, its provisions by signing the attached certification. Copies of the SSP will be included in the FTN project files and will be carried to the site by field personnel.

1.3 Training and Medical Surveillance

It is the responsibility of each employer to determine if their employees meet the requirements for medical surveillance according to 29 CFR 1910.120(f). Each contractor is

responsible for compliance with all applicable standards and regulations. FTN requires subcontractor's personnel to be adequately trained in the performance of their duties.

In regard to site safety policies, FTN and subcontractor(s) will receive specific information from the Arkansas Department of Environmental Quality (ADEQ) as necessary.

2.0 SITE DESCRIPTION

2.1 Site Location and Background

The Northwest Arkansas Waste Management, Inc. ("Parsons") Landfill is a closed facility including both Class 1 and Class 4 landfills that had a history of operational problems, leachate problems, and groundwater issues. The Class 1 landfill was a trench-fill operation and the Class 4 landfill was a ravine-fill operation. The Landfill is located on approximately 140 acres, about 3 miles east of Springdale and about 1 mile north of US-412, in Washington County, Arkansas. Problems associated with groundwater and surface water impacts, inadequate soil cover, lack of vegetative cover, erosion, differential settling, ponding of water, and methane gas generation have been noted in recent years by ADEQ. ADEQ is conducting this site investigation to:

1. Determine to what extent the release of contaminants has impacted the subject property and surrounding property and groundwater/surface water in the vicinity;
2. Determine if landfill gas (LFG) is migrating offsite;
3. Determine the risks to human health and the environment associated with the contaminants; and
4. After site characterization is completed, depending on the findings, decide on design and implementation of remedial measures.

The site is currently being used to pasture cattle. The general topography of the Class 1 landfill area is relatively flat but steep slopes and ravines bound portions of the site. Differential settling in the areas used for trench fill have resulted in an undulating surface with fissuring of the surface and depressions as deep as 10 ft. Gas vents and leachate wells (many of which are broken off or otherwise damaged) are located in the trench fill area. A 3-inch natural gas distribution line, owned and maintained by Arkansas Western Gas Company, crosses the site.

2.2 Scope of Work Activities

The project scope of work is attached to this SSP (Attachment 2).

3.0 ONSITE ORGANIZATION, COORDINATION, AND CONTROL

The following personnel are designated to carry out the stated job functions onsite:

ADEQ PROJECT COORDINATOR	Bryan Leamons, PE
ASSOCIATE/PROJECT MANAGER	Paul Crawford, PE, PG
PROJECT HYDROGEOLOGIST	Dianne Lincicome, PE, PG
FTN FIELD TEAM MEMBERS	Dana Derrington (site geologist)
	Curtis Nunn, PG (site geologist)
	Jacob Brickman (environmental scientist)
	Mark Koch (environmental scientist)
SUBCONTRACTOR	
Drilling Contractor:	

4.0 HAZARD EVALUATION

4.1 Chemical Hazards

Based upon FTN's initial evaluation of the Parsons Landfill site, chemical hazards present at the site include explosive gas that has been measured in gas vents and/or leachate wells, and volatile organic compounds (VOCs) and elevated metals that have been measured in groundwater and surface water. Preliminary review of existing data shows that:

- VOCs and semi-volatile organic compounds (SVOCs) reported at levels exceeding United States Environmental Protection Agency (USEPA) Region 6 Human Health Medium–Specific Screening Levels (HHMSSLs) for residential water and/or maximum contaminant levels (MCLs) in samples include bromodichloromethane, benzene, carbon tetrachloride, chloroform, chloroethane, 1,2-dichloropropane, 1,4-dichlorobenzene, dibromochloromethane, methylene chloride, naphthalene, tetrachloroethylene, 1,1,2,2-tetrachloroethane, trichloroethylene, and vinyl chloride.
- Metals reported at levels exceeding residential water HHMSSLs and/or MCLs in samples include arsenic, cadmium, mercury, lead, manganese, and nickel.

4.2 Physical and Biological Hazards

The hazards of the site include biological hazards (such as snakes, fire ants, poison ivy, etc.), and physical hazards including steep slopes and ravines that bound portions of the site and hazards that may arise when working near heavy equipment. Differential settling in the areas used for trench fill have fissuring of the surface and depressions as deep as 10 ft. Extra care should be taken to maintain footing in areas of steep slopes and fissuring. General common sense rules for equipment operation are as follows:

1. Inspect equipment before operation to be sure it is in good operating condition.
2. Before moving machine, make sure people are clear.
3. Slow down when backing up, or when on ramps and curves.
4. Allow for safe stopping distances.
5. Do not drive through dust clouds.
6. Exercise caution on slopes or near banks.

7. Follow decontamination procedures for equipment.
8. Use designated parking areas and shut down procedures.
9. Always wear a hard hat and foot protection.
10. Be aware of the location of the equipment near you.
11. Do not operate anything you are not qualified to.
12. Never walk in front or back of moving equipment.
13. Be aware that equipment can be a source of ignition for flammable/explosive materials.

Drill rig crews are confronted with all of these equipment hazards; therefore, maintenance and good housekeeping are constant requirements.

4.3 Heat Stress

During field activities, personnel may encounter temperatures above 70°F. Hot, humid weather can cause physical discomfort, loss of efficiency, personal injury, and in the extreme, can be life threatening; therefore, monitoring for heat stress is required.

Heat stress can be manifested in mild symptoms, such as fatigue, irritability, decreased concentration, and anxiety, to symptoms such as heat rash, heat cramps, heat exhaustion, and heat stroke.

- Heat rash is a skin irritation resulting from prolonged contact with wet clothing; it can be prevented by allowing the skin to dry completely during rest periods and by showering at the end of the day.
- Heat cramps result from the excessive loss of body fluids and electrolytes; the symptoms are spasms in the abdomen or limbs.
- Heat exhaustion results from more severe dehydration; symptoms include pale, clammy skin, profuse perspiration, weakness, headache, and nausea.
- Heat stroke is a life-threatening condition that occurs when the body's temperature-regulating system no longer functions properly; systems include hot, dry skin, a high fever (106°F or more), dizziness, nausea, rapid pulse, and unconsciousness. Brain damage and death may follow if the body temperature is not reduced.

Measures to reduce heat stress include:

- Plenty of cool liquids (water and sports drinks) will be provided at regular intervals to replace body fluids (water and electrolytes) lost due to perspiration.
- Sufficient rest periods will be taken by personnel by alternating work and rest cycles throughout the course of the day. Work and rest times are a function of the level of the protection and temperature. The geologist/engineer onsite will have the authority to require drillers to take mandatory rest periods.
- Shelter will be available to protect personnel against heat, rain, and other weather conditions, which can decrease physical efficiency and increase the probability of accidents.
- Body heat measurements may be required at the beginning, end, and optionally, during the workday.

If at any time a worker feels nauseated, or dizzy, they should immediately stop work, cool off, rest (in shaded area), and seek assistance if symptoms do not subside.

4.4 Cold Exposure

Cold injury (frostbite and hypothermia) and impaired ability to work are dangers when the temperature and/or wind-chill factor is low. To guard against cold-induced illnesses and injuries:

1. Select proper clothing for cold, wet, and windy conditions;
2. Layer clothing to adjust to changing environmental temperatures. Wear a hat and gloves, in addition to underwear that will keep water away from the skin (polypropylene);
3. Take frequent short breaks in warm dry shelters to allow the body to warm up;
4. Perform work during the warmest part of the day;
5. Avoid exhaustion or fatigue because energy is needed to keep muscles warm;
6. Use the buddy system (work in pairs);
7. Drink warm, sweet beverages (sugar water, sports-type drinks). Avoid drinks with caffeine (coffee, tea, or hot chocolate) or alcohol; and
8. Eat warm, high-calorie foods like hot pasta dishes.

Frostbite usually affects the fingers, hands, toes, feet, ears and nose. Signs and symptoms of frostbite include:

- Pale, waxy-white skin color; and
- Skin becomes hard and numb.

Measures to treat frostbite include:

1. Move the person to a warm dry area. Don't leave the person alone.
2. Remove any wet or tight clothing that may cut off blood flow to the affected area.
3. **DO NOT** rub the affected area, because rubbing causes damage to the skin and tissue.
4. **Gently** place the affected area in a warm (105°F) water bath and monitor the water temperature to **slowly** warm the tissue. Don't pour warm water directly on the affected area because it will warm the tissue too fast causing tissue damage. Warming takes about 25-40 minutes.
5. After the affected area has been warmed, it may become puffy and blister. The affected area may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area should be dried and wrapped to keep it warm. **NOTE:** If there is a chance the affected area may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage.
6. Seek medical attention as soon as possible.

Hypothermia is a medical emergency and occurs when normal body temperature (98.6°F) drops to or below 95°F. Signs and symptoms include:

1. Fatigue or drowsiness,
2. Uncontrolled shivering,
3. Cool, blueish skin,
4. Slurred speech,
5. Clumsy movements, and
6. Irrational or confused behavior.

Measures to treat hypothermia include:

1. Call for emergency help (i.e., ambulance or call 911).
2. Move the person to a warm, dry area. Don't leave the person alone. Remove any wet clothing and replace with warm, dry clothing or wrap the person in blankets.
3. Have the person drink warm, sweet drinks (sugar water or sports-type drinks) if they are alert. **Avoid drinks with caffeine** (coffee, tea, or hot chocolate) or alcohol.

Have the person move their arms and legs to create muscle heat. If they are unable to do this, place warm bottles or hot packs in the arm pits, groin, neck, and head areas. **DO NOT** rub the person's body or place them in warm water bath. This may stop their heart.

5.0 PERSONAL PROTECTIVE EQUIPMENT

The following personal protective equipment is required while drilling and associated activities are conducted at the site:

- Hard hat;
- Protective eyewear;
- Gloves; and
- Protective, steel-toed boots.

6.0 EMERGENCY INFORMATION

6.1 Emergency Response

Before initiating field activities, the Project Manager will plan emergency routes and discuss them with all personnel conducting field work for this project.

Minor medical problems will be treated on site. An ambulance will be called for major medical emergencies. These steps will be followed in case of injury:

1. Stabilize the victim before movement, if possible, particularly in case of neck or back injuries;
2. Render first aid or CPR if necessary and trained to do so;
3. Obtain paramedic services or ambulance transport to the hospital;
4. Contact FTN management with the details of the incident and corrective actions; and
5. Write a report of the incident within 24 hours of the occurrence and submit the report to the Project Manager. Any incidents requiring medical treatment require the completion of the accident report form included as Attachment 5.

FTN (and subconsultants as necessary) will be expected to provide the following safety equipment:

1. Water coolers and coolers containing thirst quenchers;
2. A portable eye wash;
3. A supply of clean water;
4. A first-aid kit. The first-aid kit should contain basic first-aid supplies such as bandages, antiseptic, and pain relievers; and
5. A fire extinguisher.

6.2 Hospitals

Northwest Medical Center is located approximately 7 miles from the site at 609 W. Maple Ave. in Springdale, Arkansas. From the site, turn left onto E. Hewitt Springs Rd./CR-570 and go about 0.8 mile to intersect US-412. Turn right and travel west approximately

5.5 miles to S. Thompson St./US 71 BR. Travel north approximately 0.5 mile and turn right at W. Maple Ave. A map of the route to this hospital is attached to this SSP (Attachment 4).

6.3 Emergency Notification

Should a medical emergency situation arise during the course of work, the following person(s) will be contacted (as necessary):

EMERGENCY PHONE NUMBERS

Name	Telephone Number
ADEQ Contact: Bryan Leamons, PE	501-682-0601
FTN Associates, Ltd. Associate: Paul Crawford, PE, PG Project Hydrogeologist: Dianne Lincicome, PE, PG Site Geologists: Curtis Nunn, PG, and Dana Derrington	501-225-7779 or 479-571-3334
Subcontractor: Drilling contractor:	
Hospitals: Northwest Medical Center of Springdale, AR	479-751-5711
Ambulance:	911
Poison Control	1-800-222-1222

ATTACHMENT 1

Site Safety Plan Approval/Sign-Off Form

SITE SAFETY PLAN
APPROVAL/SIGN-OFF FORM

I have read, understood, and agreed with the information set forth in this SSP (and attachments) and discussed in the Personnel Health and Safety briefing.

Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Project Manager	Signature	Date

Personnel Health and Safety Briefing Conducted by:

Name	Signature	Date

ATTACHMENT 2

Scope of Work Activities

SCOPE OF WORK ACTIVITIES

This project includes the following field activities:

1. Site reconnaissance;
2. Surface water sampling;
3. Surface soil sampling;
4. Groundwater sampling;
5. Leachate sampling;
6. Drilling and subsurface material sampling;
7. Monitoring well installation and development;
8. Installation of explosive gas monitoring probes and monitoring;
9. Survey of boring, monitoring well, and sampling locations; and
10. Investigation-derived waste sampling and management.

ATTACHMENT 3

Site Safety Plan Amendment Sheet

SITE SAFETY PLAN AMENDMENT FORM

Because of unforeseen changes in site conditions encountered at the Parsons Landfill site, this amendment replaces the original Section(s) of the Site Safety Plan (SSP).

Project Manager Name (Print)_____

Signature_____

Company_____

Date_____

I represent that I have been informed of the amendment to Section (s) of the original SSP for the Parsons Landfill site associated with performing work at this site. I have also been briefed as to the contents of the amendment of the SSP and agree to perform my work in accordance with it.

Name (Print)_____

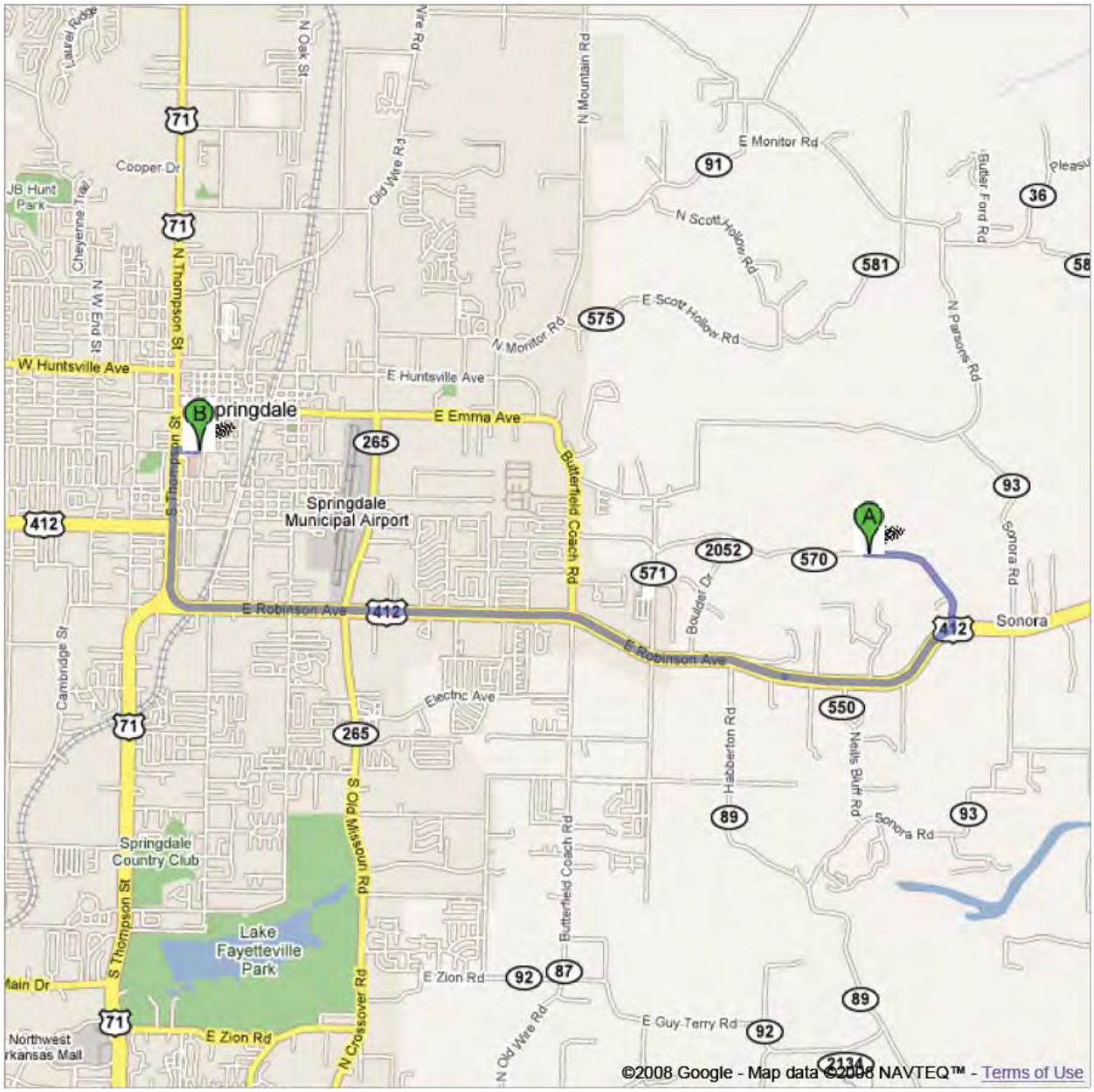
Signature_____

Company_____

Date_____

ATTACHMENT 4

Route to Northwest Medical Center in Springdale, Arkansas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Springdale
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Springdale Municipal Airport
Springdale Country Club
Lake Fayetteville Park
Northwest rkansas Mall
Sonora
E Monitor Rd
N Scott Hollow Rd
E Scott Hollow Rd
N Monitor Rd
W Huntsville Ave
E Huntsville Ave
E Emma Ave
E Robinson Ave
Electric Ave
E Zion Rd
E Guy Terry Rd
Sonora Rd
Cooper Dr
JB Hunt Park
Cheyenne Trail
N W End St
N Thompson St
S Thompson St
Cambridge St
Main Dr
N Oak St
Old Wire Rd
N Mountain Rd
Butterfield Coach Rd
Boulder Dr
Habberton Rd
Neills Bluff Rd
S Old Missouri Rd
N Crossover Rd
N Old Wire Rd
Butler Ford Rd
N Parsons Rd
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581
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2052
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571
550
89
92
87
2134
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ATTACHMENT 5

Accident Report Form

Accident Report Form

Date of this report				
Person reporting		Name of employee in accident		
Check (for injury only) 9 First aid case, or 9 Disabling (lost-time injury)				
Job title			Age	Sex
Date of injury	Time	a.m. p.m.	Place occurred	

Description of Accident (Answer for all cases)

1. What caused the accident?			
Did employee contribute to the accident?			
2. Was another person involved?	Did that person contribute to the accident?		
3. Did effective equipment or furnishings or other unsafe conditions contribute to the accident?			
4. What persons other than the injured saw the accident? Identify fully			

Physician's Statement

5. State injuries or other result, if any, form this accident			
6. What treatment was given for these injuries?			
7. Employee examined: Date	Hour	a.m. p.m.	
Signed			

Corrective Action Taken

8. What steps have been taken to prevent similar occurrences and what further recommendations are made (replace or repair equipment, instruct employee, or other action)?			
9. Follow-up dates (for Admin or Safety Comm.)	1	2	3
Comment			

For Administrative Office Use

Disabling Injury Classification		**For Cost Analysis (if desired)**
	Temporary total disability	Compensation $
	Permanent partial disability	Medical $
	Started losing time (date)	Public Liability $
	Returned to work (date)	Property Loss $
	Permanent total disability	Other (*sick time, *etc.) $
	Fatality	Total cost, this accident $

APPENDIX C

Comparison of Screening Levels to Reporting Levels

Screening Levels Applicable to Arkansas Landfill Closure and Post-Closure Activities

			Water					Soil					
	CAS No.	EPA Method	MCL	HHMSSL Residential Water	Method Detection Limit	AIC Reporting Level	Regulation #2 Acute Criteria	HHMSSL Residential	HHMSSL Industrial - Indoor Worker w/o Dermal	HHMSSL Industrial - Outdoor Worker	HHMSSL DAF 1	Method Detection Limit	AIC Reporting Level
Inorganics			**Note: Concentrations in mg/L**					**Note: Concentrations in mg/Kg**					
Chloride	na	9056			0.165000	0.2						1.65E+00	2.0E+00
Sulfate	na	9056			0.195000	0.2						1.95E+00	2.0E+00
Sulfide	18496-25-8	9030B			1.000000	1						1.0E+00	1.0E+01
TDS	na	SM 2540C			9.400000	10		na	na	na	na	na	na
Total Cyanide	57-12-5	9014	200.000	0.730	0.001300	0.01	0.02236	1.2E+03				1.3E-02	1.0E-01
Total Organic Carbon													
TOC		9060			0.041000	1							
Metals			**Note: Concentrations in mg/L**					**Note: Concentrations in mg/Kg**					
Antimony	7440-36-0	6020/6010B	0.006	0.146	0.000035	0.001		3.1E+01	8.2E+02	4.5E+02	3.0E-01	3.91E-01	1.0E+00
Arsenic (noncancer endpoint)	7440-38-2	6020/6010B	0.010		0.000950	0.001		2.2E+01	6.1E+02	2.8E+02		6.11E-01	5.0E+00
Arsenic (cancer endpoint)	7440-38-2	6020/6010B	0.010	0.0004	0.000950	0.001		3.9E-01	3.8E+00	1.8E+00	1.0E+00	6.11E-01	3.0E-01
Barium	7440-39-3	6020/6010B	2.000	7.3	0.000220	0.002		1.6E+04	1.0E+05	1.0E+05	8.2E+01	1.6E-02	2.0E-01
Beryllium	7440-41-7	6020/6010B	0.004	0.073	0.000026	0.0003	0.004	1.6E+02	2.2E+03	2.2E+03	3.0E+00	2.5E-03	3.0E-02
Cadmium	7440-43-9	6020/6010B	0.005	0.185	0.000026	0.001	***	3.9E+01	1.0E+03	5.6E+02	4.0E-01	1.9E-02	4.0E-01
Chromium (Total)	7440-47-3	6020/6010B	0.100		0.000026	0.003	***	2.1E+02	4.5E+02	5.0E+02	2.0E+00	8.0E-02	7.0E-01
Cobalt	7440-48-4	6020/6010B		0.73	0.000250	0.003		9.0E+02	1.9E+03	2.1E+03		7.6E-02	7.0E-01
Copper	7440-50-8	6020/6010B	1.300	1.36	0.000640	0.003	***	2.9E+03	7.6E+04	4.2E+04		7.5E-02	6.0E-01
Iron	7439-89-6	6020/6010B		25.6	0.002700	0.007		5.5E+04	1.0E+05	1.0E+05		5.4E-02	7.0E-01
Lead	7439-92-1	6020/6010B	0.015	0.015	0.000073	0.001	***	4.0E+02	8.0E+02	8.0E+02		3.8E-01	4.0E+00
Manganese	7439-96-5	6020/6010B		1.7	0.000420	0.002		3.5E+03	4.7E+04	3.5E+04		1.8E-02	2.0E-01
Mercury	7487-94-7	7470A	0.002	0.011	0.000063	0.0002	0.0024	2.3E+01	6.1E+02	3.4E+02		3.2E-02	1.0E-01
Nickel	7440-02-0	6020/6010B		0.73	0.000330	0.004	***	1.6E+03	4.1E+04	2.3E+04	7.0E+00	1.4E-02	1.0E+00
Selenium	7782-49-2	6020/6010B	0.050	0.183	0.000270	0.002	0.02	3.9E+02	1.0E+04	5.7E+03	3.0E-01	9.9E-01	7.0E+00
Silver	7440-22-4	6020/6010B		0.183	0.000033	0.0003	***	3.9E+02	1.0E+04	5.7E+03	2.0E+00	1.3E-01	1.0E+00
Thallium	(Total)	6020/6010B	0.002	0.003	0.000009	0.001		5.5E+00	1.4E+02	7.9E+01	4.0E-01	5.2E-01	1.0E+00
Tin	(Total)	6020/6010B		21.9	0.010000	0.2		4.7E+04	1.0E+05	1.0E+05		2.1E-01	1.0E+00
Vanadium	7440-62-2	6020/6010B		0.183	0.000980	0.003		3.9E+02	1.0E+04	5.7E+03	3.0E+02	1.4E-01	1.0E+00
Zinc	7440-66-6	6020/6010B		11	0.000900	0.002	***	2.3E+04	1.0E+05	1.0E+05	6.2E+02	1.4E-01	2.0E-01
8015 Method			**Note: Concentrations in mg/L**					**Note: Concentrations in mg/Kg**					
Isobutyl alcohol	78-83-1	8015B			0.100000	10						na	na
SVOCs			**Note: Concentrations in ug/L**					**Note: Concentrations in mg/Kg**					
Acenapthene	83-32-9	8270C		365	0.338000	10		3.7E+03	3.8E+04	3.3E+04	2.9E+01	2.3E-02	6.6E-01
Acenapthylene	208-96-8	8270C			0.469000	10						3.2E-02	6.6E-01
Acetophenone	98-86-2	8270C		608	10.000000	10		1.7E+03	1.7E+03	1.7E+03		6.6E-01	6.6E-01
2-Acetylaminofluorene (or 2-AAF)	53-96-3	8270C			20.000000	20						6.6E-01	6.6E-01
4-Aminobiphenyl	92-67-1	8270C			20.000000	20						6.6E-01	6.6E-01
Anthracene	120-12-7	8270C		1825	0.272000	10		2.2E+04	1.0E+05	1.0E+05	5.9E+02	1.9E-02	6.6E-01
Benzo(a)anthracene	56-55-3	8270C		0.03	0.347000	10		1.5E-01	7.8E+00	2.3E+00	8.0E-02	2.4E-02	6.6E-01
Benzo(a)pyrene	50-32-8	8270C	0.20	0.003	0.236000	10		1.5E-02	7.8E-01	2.3E-01	4.0E-01	1.6E-02	6.6E-01
Benzo(b)fluoranthene	205-99-2	8270C		0.03	0.228000	10		1.5E-01	7.8E+00	2.3E+00	2.0E-01	1.6E-02	6.6E-01
Benzo(ghi)perylene	191-24-2	8270C			0.709000	10						4.8E-02	6.6E-01
Benzo(k)fluoranthene	207-08-9	8270C		0.294985	0.648000	10		1.5E+00	7.8E+01	2.3E+01	2.0E+00	4.4E-02	6.6E-01
Benzyl alcohol	100-51-6	8270C		10950.0000	0.629000	20		1.8E+04	1.0E+05	1.0E+05		4.2E-02	1.3E+00
Bis(2-chloro-1-methylethyl) ether	108-60-1	8270C			10.000000	10		2.9E+00	8.1E+00	8.2E+00		6.6E-01	6.6E-01
Bis(2-Chloroethoxy)methane	111-91-1	8270C			0.549000	10						3.7E-02	6.6E-01
Bis(2-chloroethyl)ether (or Dichloroethyl ether)	111-44-4	8270C		0.009800	0.549000	10		2.1E-05	6.2E-01	6.2E-01	2.0E-05	3.7E-02	6.6E-01
Bis(2-ethylhexyl)phthalate (DEHP)	117-81-7	8270C	6.00	4.800000	0.499000	5		3.5E+01	4.1E+02	1.4E+02	1.8E+02	3.4E-02	6.6E-01
4-Bromophenyl phenyl ether	101-55-3	8270C			0.604000	10						4.1E-02	6.6E-01
Butyl benzyl phthalate	85-68-7	8270C		7300.000000	0.349000	10		2.4E+02	2.4E+02	2.4E+02	8.1E+02	2.4E-02	6.6E-01
Chlorobenzilate	510-15-6	8270C		0.249006	10.000000	10		1.8E+00	2.1E+01	7.1E+00		6.6E-01	6.6E-01

	CAS No.	EPA Method	Water					Soil					
			MCL	HHMSSL Residential Water	Method Detection Limit	AIC Reporting Level	Regulation #2 Acute Criteria	HHMSSL Residential	HHMSSL Industrial - Indoor Worker w/o Dermal	HHMSSL Industrial - Outdoor Worker	HHMSSL DAF 1	Method Detection Limit	AIC Reporting Level
2-Chloronapthalene	91-58-7	8270C			0.510000	10						3.4E-02	6.6E-01
2-Chlorophenol	95-57-8	8270C		30.416667	0.399000	10		6.4E+01	2.4E+02	2.6E+02	2.0E-01	2.7E-02	6.6E-01
4-Chlorophenyl phenyl ether	7005-72-3	8270C			0.780000	10						5.2E-02	6.6E-01
Chrysene	218-01-9	8270C		2.949853	0.211000	2.9		1.5E+01	7.8E+02	2.3E+02	8.0E+00	1.5E-02	6.6E-01
Di-n-butyl phthalate	84-74-2	8270C			0.986000	10						6.6E-02	6.6E-01
di-n-Octyl phthalate	117-84-0	8270C			0.648000	10						4.4E-02	6.6E-01
Diallate	2303-16-4	8270C			10.000000	10						6.6E-01	6.6E-01
Dibenz[ah]anthracene	53-70-3	8270C		0.002950	1.529000	10		1.5E-02	7.8E-01	2.3E-01	8.0E-02	1.0E-01	6.6E-01
Dibenzofuran	132-64-9	8270C		12.166667	0.592000	10		1.5E+02	2.5E+03	1.7E+03		4.0E-02	6.6E-01
3,3-Dichlorobenzidine	91-94-1	8270C		0.149403	15.557000	20		1.1E+00	1.3E+01	4.3E+00	3.0E-04	1.0E+00	1.1E+00
2,4-Dichlorophenol	120-83-2	8270C		109.500000	0.463000	10		1.8E+02	6.1E+03	2.1E+03	5.0E-02	3.1E-02	6.6E-01
2,6-Dichlorophenol	87-65-0	8270C			10.000000	10						6.6E-01	6.6E-01
Diethyl phthalate	84-66-2	8270C		29200.00000	0.483000	10		4.9E+04	1.0E+05	1.0E+05		3.3E-02	6.6E-01
Dimethoate	60-51-5	8270C			20.000000	20						6.6E-01	6.6E-01
Dimethyl phthalate	131-11-3	8270C		365000.0000	0.501000	10		1.0E+05	1.0E+05	1.0E+05		3.4E-02	6.6E-01
7,12-Dimethylbenz(a)anthracene	57-97-6	8270C			10.000000	10						6.6E-01	6.6E-01
3,3'-Dimethylbenzidine	119-93-7	8270C		0.029231	10.000000	10		2.1E-01	2.5E+00	8.3E-01		6.6E-01	6.6E-01
2,4-Dimethylphenol	105-67-9	8270C		730.000000	0.776000	10		1.2E+03	4.1E+04	1.4E+04	4.0E-01	5.2E-02	3.3E+00
4,6-Dinitro-o-cresol (or 4,6-Dinitro-2-methylphenol)	534-52-1	8270C			0.341000	50						2.3E-02	6.6E-01
2,4-Dinitrophenol	51-28-5	8270C		73.000000	0.308000	50		1.2E+02	4.1E+03	1.4E+03	1.0E-02	2.1E-02	6.6E-01
2,4-Dinitrotoluene	121-14-2	8270C		73.000000	0.441000	10		1.2E+02	4.1E+03	1.4E+03	4.0E-05	3.0E-02	6.6E-01
2,6-Dinitrotoluene	606-20-2	8270C		36.500000	0.581000	10		6.1E+01	2.0E+03	6.8E+02	3.0E-05	3.9E-02	6.6E-01
Dinoseb	88-85-7	8270C	7.00	36.500000	20.000000	20		6.1E+01	2.0E+03	6.8E+02		6.6E-01	6.6E-01
Diphenylamine	122-39-4	8270C		912.500000	10.000000	10		1.5E+03	5.1E+04	1.7E+04		6.6E-01	6.6E-01
Disulfoton	298-04-4	8270C		1.460000	10.000000	10		2.4E+00	8.2E+01	2.7E+01		6.6E-01	6.6E-01
Ethyl methanesulfonate	62-50-0	8270C			20.000000	20						6.6E-01	6.6E-01
Famphur	52-85-7	8270C			20.000000	20						6.6E-01	6.6E-01
Fluoranthene	206-44-0	8270C		1460.000000	0.378000	10		2.3E+03	8.2E+04	2.4E+04	2.1E+02	2.6E-02	6.6E-01
Fluorene	86-73-7	8270C		243.333333	0.635000	10		2.6E+03	3.3E+04	2.6E+04	2.8E+01	4.3E-02	6.6E-01
Hexachlorobenzene	118-74-1	8270C	1.00	0.042020	0.835000	1		3.0E-01	3.6E+00	1.2E+00	1.0E-01	5.6E-02	6.6E-01
Hexachlorobutadiene	87-68-3	8270C		0.861943	0.688000	10		6.2E+00	7.3E+01	2.5E+01	1.0E-01	4.6E-02	6.6E-01
Hexachlorocyclopentadiene	77-47-4	8270C	50.00	219.000000	0.580000	10		3.7E+02	1.2E+04	4.1E+03	2.0E+01	3.9E-02	6.6E-01
Hexachloroethane	67-72-1	8270C		4.802252	0.498000	5		3.5E+01	4.1E+02	1.4E+02	2.0E-02	3.4E-02	6.6E-01
Hexachlorophene	70-30-4	8270C		10.950000	10.000000	10		1.8E+01	6.1E+02	2.1E+02		6.6E-01	6.6E-01
Indeno(1,2,3-cd)pyrene	193-39-5	8270C		0.029499	1.464000	10		1.5E-01	7.8E+00	2.3E+00	7.0E-01	9.8E-02	6.6E-01
Isodrin	465-73-6	8270C			10.000000	10						6.6E-01	6.6E-01
Isophorone	78-59-1	8270C		70.770036	0.409000	10		5.1E+02	6.0E+03	2.0E+03	3.0E-02	2.7E-02	6.6E-01
Isosafrole	120-58-1	8270C			10.000000	10						6.6E-01	6.6E-01
Kepone	143-50-0	8270C		0.008404	10.000000	10		6.1E-02	7.2E-01	2.4E-01		6.6E-01	6.6E-01
1,3-Dinitrobenzene (or m-dinitrobenzene)	99-65-0	8270C		3.650000	0.453000	4		6.1E+00	2.0E+02	6.8E+01		3.1E-02	6.6E-01
m-Nitroaniline (or 3-Nitroanile)	99-09-2	8270C			0.409000	50						2.8E-02	6.6E-01
m&p-cresols	n/a	8270C			0.566000	10						3.8E-02	6.6E-01
m-Cresol (or 3-methylphenol)	108-39-4	8270C			1.000000	*							*
o-Cresol (or 2-methylphenol)	95-48-7	8270C			0.567000	10					8.0E-01	3.8E-02	6.6E-01
p-Cresol (or 4-methylphenol)	106-44-5	8270C		180.000000	1.000000	*		3.1E+02	1.0E+04	3.4E+03			*
Methapyrilene	91-80-5	8270C			10.000000	10						6.6E-01	6.6E-01
Methyl methanesulfonate	66-27-3	8270C			10.000000	10						6.6E-01	6.6E-01
Methyl parathion	298-00-0	8270C		9.125000	10.000000	10		1.5E+01	5.1E+02	1.7E+02		6.6E-01	6.6E-01
3-Methylcholanthrene	56-49-5	8270C			10.000000	10						6.6E-01	6.6E-01
2-Methylnapthalene	91-57-6	8270C			0.653000	10						4.4E-02	6.6E-01
N-Nitrosodi-n-butylamine	924-16-3	8270C		0.002013	10.000000	10		2.4E-02	6.2E-02	6.5E-02		6.6E-01	6.6E-01

	CAS No.	EPA Method	Water					Soil					
			MCL	HHMSSL Residential Water	Method Detection Limit	AIC Reporting Level	Regulation #2 Acute Criteria	HHMSSL Residential	HHMSSL Industrial - Indoor Worker w/o Dermal	HHMSSL Industrial - Outdoor Worker	HHMSSL DAF 1	Method Detection Limit	AIC Reporting Level
N-Nitrosodiethylamine	55-18-5	8270C		0.000144	20.000000	20		7.7E-04	3.8E-02	1.3E-02		6.6E-01	6.6E-01
N-Nitrosodimethylamine	62-75-9	8270C		0.000422	5.000000	5		2.3E-03	1.1E-01	3.8E-02		3.4E-01	6.6E-01
N-Nitrosodiphenylamine	86-30-6	8270C		13.720721	0.418000	5		9.9E+01	1.2E+03	3.9E+02	6.0E-02	2.8E-02	6.6E-01
N-Nitroso di-n-propylamine	621-64-7	8270C		0.009605	0.586000	10		6.9E-02	8.2E-01	2.7E-01	2.0E-06	4.0E-02	6.6E-01
N-Nitroso-N-methylethylamine	10595-95-6	8270C		0.003056	10.000000	10		2.2E-02	2.6E-01	8.7E-02		6.6E-01	6.6E-01
N-Nitrosopiperidine	100-75-4	8270C			20.000000	20						6.6E-01	6.6E-01
N-Nitrosopyrrolidine	930-55-2	8270C		0.032015	40.000000	40		2.3E-01	2.7E+00	9.1E-01		6.6E-01	6.6E-01
Naphthalene	91-20-3	8270C		6.202941	0.651000	6		1.2E+02	1.9E+02	2.1E+02	4.0E+00	4.4E-02	6.6E-01
1,4-Napthoquinone	130-15-4	8270C			10.000000	10						6.6E-01	6.6E-01
1-Napthylamine	134-32-7	8270C			10.000000	10						6.6E-01	6.6E-01
2-Napthylamine	91-59-8	8270C			10.000000	10						6.6E-01	6.6E-01
5-Nitro-o-toluidine	99-55-8	8270C			10.000000	10						6.6E-01	6.6E-01
o-Nitroaniline (or 2-Nitroaniline)	88-74-4	8270C		109.500000	0.374000	50		1.8E+02	5.9E+03	2.0E+03		2.5E-02	3.3E+00
o-Nitrophenol (or 2-Nitrophenol)	88-75-5	8270C			0.332000	10						2.3E-02	6.6E-01
O,O,O-Triethyl phosphorothioate	126-68-1	8270C			10.000000	10						6.6E-01	6.6E-01
o-Toluidine	95-53-4	8270C			10.000000	10						6.6E-01	6.6E-01
p-(Dimethylamino)azobenzene	60-11-7	8270C			10.000000	10						6.6E-01	6.6E-01
p-Chloro-m-cresol (or 4-Chloro-3methylphenol)	59-50-7	8270C			0.566000	20						3.8E-02	6.6E-01
p-Chloroaniline (or 4-Chloroaniline)	106-47-8	8270C		146.000000	0.651000	20		2.4E+02	8.2E+03	2.7E+03	3.0E-02	4.4E-02	6.6E-01
p-Nitroaniline (or 4-Nitroaniline)	100-01-6	8270C			0.533000	20						3.6E-02	3.3E+00
p-Nitrophenol (or 4-Nitrophenol)	100-02-7	8270C		292.000000	0.869000	50		4.9E+02	1.6E+04	5.5E+03		5.8E-02	3.3E+00
p-Phenylenediamine	106-50-3	8270C		6935.000000	10.000000	10		1.2E+04	1.0E+05	1.0E+05		6.6E-01	6.6E-01
Parathion	56-38-2	8270C		219.000000	10.000000	10		3.7E+02	1.2E+04	4.1E+03		6.6E-01	6.6E-01
Pentachlorobenzene	608-93-5	8270C		29.200000	10.000000	10		4.9E+01	1.6E+03	5.5E+02		6.6E-01	6.6E-01
Pentachloronitrobenzene	82-68-8	8270C		0.258583	20.000000	20		1.9E+00	2.2E+01	7.4E+00		6.6E-01	6.6E-01
Pentachlorophenol	87-86-5	8270C	1.00	0.560263	0.534000	1	****	3.0E+00	4.8E+01	1.0E+01	1.0E-03	3.6E-02	6.6E-01
Phenacetin	62-44-2	8270C			10.000000	10						6.6E-01	6.6E-01
Phenathrene	85-01-8	8270C			0.415000	10						2.8E-02	6.6E-01
Phenol	108-95-2	8270C		10950.0000	0.510000	10		1.8E+04	1.0E+05	1.0E+05	5.0E+00	3.4E-02	6.6E-01
Phorate	298-02-2	8270C			10.000000	10						6.6E-01	6.6E-01
Pronamide	23950-58-5	8270C			10.000000	10						6.6E-01	6.6E-01
Pyrene	129-00-0	8270C		182.500000	0.456000	10		2.3E+03	5.4E+04	3.2E+04	2.1E+02	3.1E-02	6.6E-01
Safrole	94-59-7	8270C			10.000000	10						6.6E-01	6.6E-01
sym-Trinitrobenzene	99-35-4	8270C			10.000000	10						6.6E-01	6.6E-01
1,2,4,5-Tetrachlorobenzene	95-94-3	8270C		10.950000	10.000000	10		1.8E+01	6.1E+02	2.1E+02		6.6E-01	6.6E-01
2,3,4,6-Tetrachlorophenol	58-90-2	8270C		1095.000000	0.773000	10		1.8E+03	6.1E+04	2.1E+04		5.2E-02	6.6E-01
Thionazine	n/a	8270C			20.000000	20						6.6E-01	6.6E-01
1,2,4-Trichlorobenzene	120-82-1	8270C	70.00	8.156425	0.655000	8		1.4E+02	2.4E+02	2.6E+02	3.0E-01	4.4E-02	6.6E-01
2,4,5-Trichlorophenol	95-95-4	8270C		3650.000000	0.450000	10		6.1E+03	1.0E+05	6.8E+04	1.4E+01	3.0E-02	6.6E-01
2,4,6-Trichlorophenol	88-06-2	8270C		6.111958	0.590000	6		4.4E+01	5.2E+02	1.7E+02	8.0E-03	4.0E-02	6.6E-01
VOCs			**Note: Concentrations in ug/L**					**Note: Concentrations in mg/Kg**					
Acetone	67-64-1	8260B		5500.000000	0.920000	5		na	n/a	n/a	n/a	n/a	n/a
Acetonitrile	75-05-8	8260B		120.000000	1.400000	100		na	na	na	na	na	na
Acrolein	107-02-8	8260B		0.041619	7.300000	50		na	na	na	na	na	na
Acrylonitrile	107-13-1	8260B			1.800000	10		na	na	na	na	na	na
Allyl chloride	107-05-1	8260B		1825.000000	0.230000	100		na	na	na	na	na	na
Benzene	71-43-2	8260B	5.00	0.350000	0.057000	0.24		na	na	na	na	na	na
Bromochloromethane	74-97-5	8260B			0.200000	0.26		na	na	na	na	na	na
Bromodichloromethane	75-27-4	8260B		0.180000	0.230000	0.23		na	na	na	na	na	na
Bromoform (tribromomethane)	75-25-2	8260B		8.500000	0.130000	0.14		na	na	na	na	na	na
Carbon disulfide	75-15-0	8260B		1042.857143	0.140000	0.36		na	na	na	na	na	na

			Water					Soil					
	CAS No.	EPA Method	MCL	HHMSSL Residential Water	Method Detection Limit	AIC Reporting Level	Regulation #2 Acute Criteria	HHMSSL Residential	HHMSSL Industrial - Indoor Worker w/o Dermal	HHMSSL Industrial - Outdoor Worker	HHMSSL DAF 1	Method Detection Limit	AIC Reporting Level
Carbon tetrachloride	56-23-5	8260B	5.00	0.171300	0.150000	0.22		na	na	na	na	na	na
Chlorobenzene	108-90-7	8260B	100.00	91.250000	0.120000	0.45		na	na	na	na	na	na
Chloroethane (or Ethyl chloride)	75-00-3	8260B		3.900000	0.200000	0.33		na	na	na	na	na	na
Chloroform	67-66-3	8260B		0.167048	0.120000	0.25		na	na	na	na	na	na
Chloroprene	126-99-8	8260B			0.048000	20		na	na	na	na	na	na
1,2-Dibromo-3-chloropropane (DBCP)	96-12-8	8260B		0.000204	0.150000	0.69		na	na	na	na	na	na
Dibromochloromethane	124-48-1	8260B		0.133405	0.075000	0.21		na	na	na	na	na	na
1,2-Dibromoethane (EDB)	106-93-4	8260B		0.005603	0.190000	0.25		na	na	na	na	na	na
trans-1,4-Dichloro-2-butene	110-57-6	8260B		0.001205	0.052000	1		na	na	na	na	na	na
Dichlorodifluoromethane	75-71-8	8260B		394.594595	0.130000	5		na	na	na	na	na	na
1,1-Dichloroethane	75-34-3	8260B		1216.666667	0.150000	0.38		na	na	na	na	na	na
1,2-Dichloroethane (EDC)	107-06-2	8260B	5.00	0.123143	0.130000	0.7		na	na	na	na	na	na
1,1-Dichloroethylene	75-35-4	8260B	7.00	338.843648	0.150000	0.38		na	na	na	na	na	na
1,2-Dichloroethylene (cis)	156-59-2	8260B	70.00	60.833333	0.130000	0.16		na	na	na	na	na	na
1,2-Dichloroethylene (trans)	156-60-5	8260B	100.00	106.829268	0.057000	0.19		na	na	na	na	na	na
1,2-Dichloropropane	78-87-5	8260B	5.00	0.164794	0.120000	0.27		na	na	na	na	na	na
1,3-Dichloropropane	142-28-9	8260B		121.666667	0.047000	5		na	na	na	na	na	na
2,2-Dichloropropane (or Isopropylidene chloride)	594-20-7	8260B			0.190000	15		na	na	na	na	na	na
1,1-Dichloropropene	563-58-6	8260B			0.100000	1		na	na	na	na	na	na
1,3-Dichloropropene (cis- and trans screening levels not available)	542-75-6	8260B		0.395492	0.060000	0.19/0.13		na	na	na	na	na	na
Ethylbenzene	100-41-4	8260B	700.00	1339.873418	0.057000	0.5		na	na	na	na	na	na
Ethyl methacrylate	97-63-2	8260B		547.500000	0.220000	10		na	na	na	na	na	na
2-Hexanone (or Methyl butyl ketone)	591-78-6	8260B			0.270000	0.53		na	na	na	na	na	na
1,3-Dichlorobenzene (or m-Dichlorobenzene)	541-73-1	8260B		14.479339	0.030000	5		na	na	na	na	na	na
Methacrylonitrile	126-98-7	8260B		1.042857	1.320000	100		na	na	na	na	na	na
4-Methyl-2-pentanone (or Methyl isobutyl ketone)	108-10-1	8260B		2000.000000	0.070000	0.5		na	na	na	na	na	na
Methyl bromide (Bromomethane)	74-95-3	8260B		60.833333	0.500000	0.26		na	na	na	na	na	na
Methyl chloride (Chloromethane)	75-09-2	8260B	5.00	4.275632	0.050000	0.14		na	na	na	na	na	na
Methyl ethyl ketone	78-93-3	8260B		7064.516129	0.070000	1.3		na	na	na	na	na	na
Methyl iodide (or Iodomethane)	74-88-4	8260B			0.100000	0.29		na	na	na	na	na	na
Methyl methacrylate	80-62-6	8260B		1400.000000	0.070000	30		na	na	na	na	na	na
Methylene bromide (Dibromomethane)	74-95-3	8260B		60.833333	0.090000	0.36		na	na	na	na	na	na
Methylene chloride	75-09-2	8260B	5.00	4.275632	0.050000	1		na	na	na	na	na	na
o-Dichlorobenzene (or 1,2-Dichlorobenzene)	95-50-1	8260B	600.00	49.305816	0.040000	0.8		na	na	na	na	na	na
p-Dichlorobenzene (or 1,4-Dichlorobenzene)	106-46-7	8260B	75.00	0.466916	0.020000	0.8		na	na	na	na	na	na
Propionitrile (or Ethyl cyanide)	107-12-0	8260B			0.700000	150		na	na	na	na	na	na
Styrene	100-42-5	8260B	100.00	1641.085271	0.030000	0.15		na	na	na	na	na	na
1,1,1,2-Tetrachloroethane	630-20-6	8260B		0.432386	0.030000	0.18		na	na	na	na	na	na
1,1,2,2-Tetrachloroethane	79-34-5	8260B		0.055338	0.060000	0.16		na	na	na	na	na	na
Tetrachloroethylene (PCE)	127-18-4	8260B	5.00	0.104520	0.110000	0.5		na	na	na	na	na	na
Toluene	108-88-3	8260B	1000.00	2281.249501	0.040000	0.5		na	na	na	na	na	na
1,1,1-Trichloroethane	71-55-6	8260B	200.00	73000.00000	0.020000	0.22		na	na	na	na	na	na
1,1,2-Trichloroethane	79-00-5	8260B	5.00	0.199513	0.050000	0.22		na	na	na	na	na	na
Trichloroethylene (TCE)	79-01-6	8260B	5.00	0.028015	0.070000	0.57		na	na	na	na	na	na
Trichlorofluoromethane	75-69-4	8260B		1288.235294	0.055000	0.21		na	na	na	na	na	na
1,2,3-Trichloropropane	96-18-4	8260B		0.033616	0.200000	0.34		na	na	na	na	na	na
Vinyl acetate	108-05-4	8260B		412.429379	0.015000	0.34		na	na	na	na	na	na
Vinyl chloride	75-01-4	8260B	2.00	0.015000	0.043000	0.26		na	na	na	na	na	na
Xylenes	1330-20-7	8260B	10000.0	202.777778	0.410000	0.7		na	na	na	na	na	na

	CAS No.	EPA Method	Water					Soil					
			MCL	HHMSSL Residential Water	Method Detection Limit	AIC Reporting Level	Regulation #2 Acute Criteria	HHMSSL Residential	HHMSSL Industrial - Indoor Worker w/o Dermal	HHMSSL Industrial - Outdoor Worker	HHMSSL DAF 1	Method Detection Limit	AIC Reporting Level
Organochlorine Pesticides			**Note: Concentrations in ug/L**					**Note: Concentrations in mg/Kg**					
Aldrin	309-00-2	8081A		0.003955	0.000700	0.04	3.0	2.9E-02	3.4E-01	1.1E-01	2.0E-02	4.7E-05	2.7E-03
HCH (alpha) (or Alpha-BHC)	319-84-6	8081A		0.010672	0.002100	0.03	2.0**/.0373	9.0E-02	9.1E-01	4.0E-01	3.0E-05	1.4E-04	2.0E-03
HCH (beta) (or Beta-BHC)	319-85-7	8081A		0.037351	0.006000	0.06		3.2E-01	3.2E+00	1.4E+00	1.0E-04	4.0E-04	2.7E-03
HCH (gamma) Lindane	58-89-9	8081A	0.20	0.051717	0.002100	0.04		4.4E-01	4.4E+00	1.9E+00	5.0E-04	1.4E-04	2.7E-03
HCH-technical (or Delta-BHC)	608-73-1	8081A		0.037351	0.004000	0.09		3.2E-01	3.2E+00	1.4E+00	1.0E-04	2.7E-04	6.0E-03
DDD	72-54-8	8081A		0.280131	0.000800	0.11		2.4E+00	2.4E+01	1.1E+01	8.0E-01	5.3E-05	7.4E-03
DDE	72-55-9	8081A		0.197740	0.001500	0.04		1.7E+00	1.7E+01	7.8E+00	3.0E+00	1.0E-04	2.7E-03
DDT	50-29-3	8081A		0.197740	0.002500	0.12	1.1	1.7E+00	1.7E+01	7.8E+00	2.0E+00	1.7E-04	8.0E-03
Dieldrin	60-57-1	8081A		0.004202	0.001500	0.02	2.5/.0012	3.0E-02	3.6E-01	1.2E-01	2.0E-04	1.0E-04	1.3E-03
Endosulfan I	959-98-8	8081A			0.002000	0.14	0.22**					1.3E-04	9.4E-03
Endosulfan II	33213-65-9	8081A			0.002000	0.04						1.3E-04	2.7E-03
Endosulfan Sulfate	1031-07-8	8081A			0.004200	0.66						2.8E-04	4.4E-02
Endrin	72-20-8	8081A	2.00	10.950000	0.000620	0.06	0.18**	1.8E+01	6.1E+02	2.1E+02	5.0E-02	4.1E-05	4.0E-03
Endrin Aldehyde	7421-93-4	8081A			0.000420	0.23						2.8E-05	1.5E-02
Heptachlor	76-44-8	8081A	0.10	0.014940	0.000620	0.03	0.52	1.1E-01	1.3E+00	4.3E-01	1.0E+00	4.1E-05	2.0E-03
Heptachlor epoxide	1024-57-3	8081A	0.20	0.007388	0.000920	0.83		5.3E-02	6.3E-01	2.1E-01	3.0E-02	6.1E-05	5.3E-02
Methoxychlor	72-43-5	8081A	40.00	182.500000	0.002000	1.80		3.1E+02	1.0E+04	3.4E+03	8.0E+00	1.4E-04	1.2E-01
Toxaphene	8001-35-2	8081A	3.00	0.061120	0.200000	2.40	0.73/.0063	4.4E-01	5.2E+00	1.7E+00	2.0E+00	1.4E-02	9.4E-03
Polychlorinated biphenyls (PCBs)			**Note: Concentrations in ug/L**					**Note: Concentrations in mg/Kg**					
PCBs	1336-36-3	8082	0.50	0.033616	*****	2	0.0004	2.2E-01	2.9E+00	8.3E-01		1.0E-01	1.0E-01
Chlorinated Herbicides			**Note: Concentrations in ug/L**					**Note: Concentrations in mg/Kg**					
2,4-D (or 2,4-Dichlorophenoxya cetic acid)	94-75-7	8151A	70.00	37.000000	1.000000	12		6.9E+02	2.0E+04	8.5E+03		1.7E+01	2.4E-01
Dinoseb	88-85-7	8151A	7.00	36.500000	0.500000	0.70		6.1E+01	2.0E+03	6.8E+02		8.3E+00	1.4E-02
2,4,5-T (or 2,4,5-Trichlorophenoxy acetic acid)	93-76-5	8151A		370.000000	0.100000	2		6.1E+02	2.0E+04	6.8E+03		1.7E+00	4.0E-02
2,4,5-TP (or Silvex)	93-72-1	8151A			0.100000	2						1.7E+00	3.4E-02

Notes:

*Will be analyzed if m&p-cresols are detected.

**Includes all isomers.

***Calculation affected by hardness. These values may be adjusted by a site-specific Water Effects Ratio (WER) as defined in 40 CFR Part 31.36(c).

****Calculation affected by pH.

*****For PCBs, an MDL must be established with each Arochlor. AIC's least sensitive Arochlor has a detection of 1 ug/L.

Note: Yellow highlighted cells indicate laboratory reporting level is above screening level.

Cells containing two numbers under the Regulation #2 criteria consist of the Aquatic Life and Human Health Criteria.

APPENDIX D

Laboratory Quality Assurance Plan Excerpts

7.0 DOCUMENT CONTROL

The objectives of documentation are as follows: to provide a standardized, written program of policies, procedures and instructions; to demonstrate that adequate quality assurance and quality control procedures have been implemented; to demonstrate that accountability of the data is maintained; and to ensure traceability of analytical results. The details of which are defined in the SOP Documentation No. 0001.

American Interplex Corporation maintains control over the possession and distribution of documents that directly impact the quality of data. It is the responsibility of the Director of Quality Assurance to maintain the Quality Assurance Manual and Standard Operating Procedures. It is the responsibility of the Laboratory Managers to ensure that document control files are created and maintained for all applicable documents originating in their areas. This includes Standard/Reagent documentation, laboratory bench sheets, calibrations, standard operating procedures, and instrument maintenance.

Full (distribution records are maintained) or limited document control (no record of distribution is maintained) is applied, depending upon the purpose of the document. Those publications, which document QA Manual and Standard Operating Procedures, are subject to full document control with the exception of those provided to Client Services to be used in contract or proposal submissions. Full control documents establishing company policy are approved by Laboratory management. The original documents along with any revisions are maintained and traceable for a minimum of 10 years. A copy of such documents used in contracts or proposal submissions will be maintained in the client files. However, the client will not automatically be supplied revisions of the submitted documents should they occur. Limited document control procedures are employed for other relevant documents, such as forms and organizational charts. These documents would be available through reviewing laboratory records; however, an individual or separate file is not created and maintained showing the original, subsequent revisions, or distribution.

Every controlled document/form or book is assigned a unique identification (usually a title, form or book number, and a creation/revision date). This unique identification is entered on a master list of documents, along with a distribution list for each document to ensure that pertinent documents are made available wherever they are essential. The status of each document, active/current/revised or inactive/obsolete, is indicated. Each document and subsequent revisions must be reviewed and approved by authorized personnel prior to issue. Personnel authorized to review and approve a document are to have access to all necessary information on which to base their review and approval. Obsolete documents are to be retrieved from distribution points and replaced with current versions.

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9.0 SAMPLING, SAMPLE PRESERVATION, AND HANDLING PROCEDURES

The quality of analytical results is highly dependent upon the quality of the procedures used to collect, preserve, and store samples. American Interplex Corporation recommends that clients follow sampling guidelines described in 40 CFR 136, USEPA SW-846, and state-specific sampling guidelines, if applicable. Sampling handling factors that must be taken into account to insure accurate, defensible analytical results include the following: amount of sample taken, type of container used, type of sample preservation, sample storage time, container cleanliness, proper labeling, and proper Chain of Custody documentation.

The container, preservation, and holding time information is summarized in Table 1.

AIC provides sample containers with the appropriate preservatives for our clients. The sample kits typically consist of an ice chest with dividers, specially prepared and labeled sample containers wrapped in protective material, and Chain of Custody forms. AIC keeps client-specific shipping requirements on file and utilizes major transportation carriers to ensure that shipping requirements (same-day, overnight, etc) are met.

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TABLE 1
Sample Preservation and Holding Times

PARAMETER	MATRIX	CONTAINER	PRESERVATION	HOLDING TIME
Coliform, Fecal and Total	W	P, G	Cool <10°C, 0.008% $Na_2S_2O_3$	6-24 hours
Acidity	W	P, G	Cool ≤6 °C	14 days
Alkalinity	W	P, G	Cool ≤6 °C	14 days
Ammonia	W	P, G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Biochemical Oxygen Demand	W	P, G	Cool ≤6 °C	48 hours
Bromide	W	P, G	None Required	28 days
Chemical Oxygen Demand	W	P, G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Chloride	W	P, G	None Required	28 days
Chlorine, Total Residual	W	P, G	None Required	Analyze immediately
Color	W	P, G	Cool ≤6 °C	48 hours
Cyanide, Total	W	P, G	Cool ≤6 °C, NaOH pH>12, plus 0.6 g Ascorbic acid	14 days
Cyanide, Amendable to Chlorination	W	P, G	Cool ≤6 °C, NaOH pH>12, plus 0.6 g Ascorbic acid	14 days
Fluoride	W	P, G	None Required	28 days
Hardness	W	P, G	HNO_3 pH<2	6 months
PH	W	P, G	None Required	24 hours
Kjeldahl and Organic Nitrogen	W	P, G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Metals	W	P, G	Cool ≤6 °C, HNO_3 pH<2	6 months
Nitrate	W	P, G	Cool ≤6 °C	48 hours
Nitrate-Nitrite	W	P, G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Nitrite	W	P, G	Cool ≤6 °C	48 hours
Orthophosphate	W	P. G	Cool ≤6 °C	48 hours
Oxygen, Dissolved	W	G, Bottle and Top	None Required	Analyze immediately
Phenolics, Total Recoverable	W	G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Phosphorus	W	G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Residue, Total	W	P, G	Cool ≤6 °C	7 days
Residue, Filterable (TDS)	W	P, G	Cool ≤6 °C	7 days
Residue, Nonfilterable (TSS)	W	P, G	Cool ≤6 °C	7 days
Residue, Settleable	W	P, G	Cool ≤6 °C	48 hours
Residue, Volatile	W	P, G	Cool ≤6 °C	7 days
Silica	W	P Only	Cool ≤6 °C	28 days
Specific Conductance	W	P, G	Cool ≤6 °C	28 days
Sulfate	W	P, G	Cool ≤6 °C	28 days
Sulfide	W	P, G	Cool ≤6 °C, Zinc Acetate And NaOH to pH>9	7 days
Sulfite	W	P, G	None Required	24 hours
Surfactants (MBAS)	W	P, G	Cool ≤6 °C	48 hours
Temperature	W	P, G	None Required	Analyze Immediately
Toxicity	W	P	Cool ≤6 °C	36 hours
Turbidity	W	P, G	Cool ≤6 °C	48 hours
Chromium VI	W	P, G	Cool ≤6 °C	24 hours
Mercury	W	P, G	HNO_3 pH<2	28 days

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PARAMETER	MATRIX	CONTAINER	PRESERVATION	HOLDING TIME
Oil and Grease	W	G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Organic Carbon, Total (TOC)	W	P, G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Organic Halogens, Total (TOX)	W	G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Organic Halogens, Absorbable, (AOX)	W	G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Petroleum Hydrocarbons, Total Recoverable	W	G	Cool ≤6 °C, H_2SO_4 pH<2	28 days
Petroleum Hydrocarbons, Total	W	G	Cool ≤6 °C, H_2SO_4 pH<2	7 days until extraction; 40 days after extraction
Petroleum Hydrocarbons, Volatile, (GRO)	W	G	Cool ≤6 °C HCL pH<2	14 days
Purgeable Halocarbons	W	G	Cool ≤6 °C HCL pH<2	14 days
Purgeable Aromatic Hydrocarbons (BTEX)	W	G	Cool ≤6 °C HCL pH<2	14 days
Petroleum Hydrocarbons, Extractable (DRO)	W	G	Cool ≤6 °C	7 days until extraction; 40 days after extraction
Alcohols and Glycols	W	G	Cool ≤6 °C	7 days until extraction; 40 days after extraction
Phenols	W	G	Cool ≤6 °C	7 days until extraction; 40 days after extraction
Organochlorine Pesticides and PCBs	W	G	Cool ≤6 °C	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons	W	G	Cool ≤6 °C	7 days until extraction; 40 days after extraction
Chlorinated Hydrocarbons	W	G	Cool ≤6 °C	7 days until extraction; 40 days after extraction
Organophosphorus Pesticides	W	G	Cool ≤6 °C	7 days until extraction; 40 days after extraction
Semivolatiles Organics	W	G	Cool ≤6 °C	7 days until extraction; 40 days after extraction
Volatiles	CWS	RM 5035 VOA RM 5031 125 ml RM 5032 125 ml Use Teflon-lined lids	Cool ≤6 °C	14 days
Volatiles	W No R.CL2	RM5030 VOA RM5031 VOA RM5032 VOA Use Teflon-lined lids	Cool ≤6 °C HCL pH<2	14 days
Volatiles	W w/RCL2	RM5030 VOA RM5031 VOA RM5032 VOA Use Teflon-lined lids	Collect sample in 125-ml container, which has been pre-preserved with 4 drops of 10% sodium thiosulfate solution. Gently swirl to mix sample and transfer to a 40 ml VOA vial. Cool ≤6 °C HCL pH<2	14 days
Volatiles	Solid Sediments Sludges Ash	RM 5035 40-ml vials with septum and stirring bar RM 5031/5032 125 ml wide mouth glass container with Teflon -lined lids	Cool ≤6 °C	14 days
Semivolatiles Orga. Pest PCBs Herbicides	CWS	125-ml wide mouth Teflon-lined lid	None	Extracted within 14 days and extracts analyzed within 40 days following extractions
Semivolatiles Orga. Pest PCBs Herbicides	Water -No Residual Chlorine	1-gal, 2x 0.5 gal, or 4 x 1 L amber glass container with Teflon-line lid	Cool ≤6 °C	Extracted within 14 days and extracts analyzed within 40 days following extractions

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PARAMETER	MATRIX	CONTAINER	PRESERVATION	HOLDING TIME
Semivolatiles Organo. Pest PCBs Herbicides	Water with Residual Chlorine	1-gal, 2x 0.5 gal, or 4 x 1 L amber glass container with Teflon-line lid	Add 3-ml 10% sodium thiosulfate per gallon (0r 0.008%). Addition of sodium thiosulfate solution to sample container may be performed in the laboratory prior to field use. Cool to ≤6 °C	Extracted within 14 days and extracts analyzed within 40 days following extractions
Semivolatiles Organo. Pest PCBs Herbicides	Soils Sediments Sludges Ash	250-ml wide mouth Teflon-lined lid	Cool ≤6 °C	Extracted within 14 days and extracts analyzed within 40 days following extractions

W = Aqueous, P = Plastic, G = Glass CWS= Concentrated Waste Samples

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10.0 SAMPLE CUSTODY

Standard Operating Procedures have been established for the receiving of samples into the laboratory. These procedures ensure that samples are received and properly logged into the laboratory and that all associated documentation, including Chain of Custody forms, is complete and consistent with the samples received.

Samples delivered to American Interplex Corporation are received by the Sample Management Officer. Verification of sample integrity includes the following activities:

- Temperature of sample containers upon receipt
- Chain of Custody documents
- Integrity of sample containers
- Holding Times and Preservation
- Sample clearly marked and dated
- Appropriate containers (size and type) received for the requested analysis
- Sample container labels and/or tags agree with Chain of Custody entries (identification, required analyses, etc.)

Any discrepancies observed during the initial assessment are recorded on the sample receipt form generated and Chain of Custody documents. All potential problems with a sample shipment are addressed and discussed with the client. When resolved, the login process will commence; and analysis may begin. Receipt of samples exceeding the regulatory requirements for temperature, in inappropriate containers, out of holding time, or inappropriately collected as documented by the chain of custody require that a statement be included on the analytical reports that identifies any discrepancies in the transport process and that the acceptability of the data in meeting regulatory requirements may be compromised.

During the login process, each sample is given a unique laboratory code, and a worksheet is generated. The worksheet provides the client information, sample descriptions, sample matrix information, required analyses, sample collection dates, analysis due dates, and other pertinent information. This worksheet is reviewed by client services for accuracy, completeness, and consistency of requested analyses and for client project objectives.

Laboratory security and access is important in maintaining the integrity of samples received. Access to the laboratory is limited to staff, except for the reception area and sample receiving area, which are manned during business hours and locked at all other times.

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Samples are distributed to the appropriate laboratory or kept refrigerated until they undergo analysis, unless otherwise specified. Samples are stored in one of three refrigerators, depending on the type of analysis. The temperature of each sample storage unit is monitored daily and the data recorded.

Upon completion of all analyses, samples and sample extracts are retained in refrigerated storage on holding shelves untill the fourteenth day from the report date unless other arrangements have been made in advance. At this time, the samples are either returned to the client or disposed of according to approved disposal practices. Documentation is maintained from initial receipt through final disposal. This ensures that an accurate history of the sample is generated.

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11.0 APPROVED ANALYTICAL METHODS

11.1 National Pollutant Discharge Elimination System

The methods used in the analyses of National Pollutant Discharge Elimination System (NPDES) monitoring required by the Clean Water Act of 1977 are listed in 40 CFR 136.

11.2 Safe Drinking Water Act

The EPA has established maximum contamination levels in national primary drinking water, and requires water suppliers to conform to these regulations and demonstrate compliance by testing for these contaminants.

11.3 The Resource Conservation Recovery Act (RCRA)

This act was established to manage hazardous waste. This is designed to protect ground water from contamination by hazardous waste. It also provides the framework for determining if a waste is hazardous.

11.4 Underground Storage Tank Closures

This program established the rules regarding release detection compliance for owners/operators of underground storage tank (UST) systems.

11.5 Biomonitoring

The Federal Water Pollution Control Act Amendments of 1972, 1977, and 1987 were enacted to restore and maintain the chemical, physical, and biological integrity of the nation's water. The Declaration of Goals and Policy states "It is the national goal that the discharge of toxic pollutants in toxic amounts be prohibited". To achieve the goals of this legislation, extensive effluent toxicity screening programs were conducted. Acute toxicity and chronic toxicity (short-term, low-level, adverse effects) tests were developed to provide the most favorable cost-benefit relationship possible to be used in effluent toxicity tests.

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11.6 Occupational Safety and Health Act

The Occupational Safety and Health Act as defined in 40 CFR 1910.1000 limits employees' exposure to toxic and hazardous substances in the work place. NIOSH and OSHA methods for monitoring exposure provide the information needed to modify and improve control systems, thus protecting the worker from occupational health hazards.

11.7 Analytical Methods Listing

Parameter	Method
Carbonaceous Biochemical Oxygen Demand	SM 5210B
Chemical Oxygen Demand	HACH 8000
Dissolved Oxygen	SM 4500-O C
Total Organic Oxygen	SM 5310 B,C, EPA9060
Acidity as CaCO3	SM 2310B
Total Coliform	SM 9221B, 9221C
Fecal Coliform	SM 9221CE, SM 9222D
Acute Toxicity	EPA 2000, 2002, 2021
Chronic Toxicity	EPA 1000, 1002
Biochemical Oxygen Demand	SM 5210B
Carbonaceous Alkalinity as CaCO3	SM 2320B
Chloride	EPA 300.0, 9056
Fluoride	EPA 300.0, 9056
Hardness as CaCO3	EPA 200.8, 6010B, 6020
Nitrate	EPA 300.0, 9056
Nitrite	EPA 300.0, 9056
Nitrate + Nitrite	EPA 300.0, 9056
Sulfate	EPA 300.0, 9056
Sulfide	SM, 4500-S^2F, EPA 9030B
Sulfite	SM 4500-SO_3^{2-}
Ammonia	SM 4500 NH3-E,B
Total Kjeldahl Nitrogen	SM4500 NH3-EG
Orthophosphate	SM 4500-P E
Phosphorus	SM 4500-P E
Aluminum	EPA 200.7, 200.8, 6010B, 6020
Antimony	EPA 200.7, 200.8, 6010B, 6020
Arsenic	EPA 200.7, 200.8, 6010B, 6020
Barium	EPA 200.7, 200.8, 6010B, 6020
Beryllium	EPA 200.7, 200.8, 6010B, 6020
Boron	EPA 200.7, 200.8, 6010B, 6020
Cadmium	EPA 200.7, 200.8, 6010B, 6020

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Parameter	Method
Calcium	EPA 200.7, 200.8, 6010B, 6020
Chromium	EPA 200.7, 200.8, 6010B, 6020
Chromium, Hexavalent	SM3500-CrB
Cobalt	EPA 200.7, 200.8, 6010B, 6020
Copper	EPA 200.7, 200.8, 6010B, 6020
Lead	EPA 200.7, 200.8, 6010B, 6020
Magnesium	EPA 200.7, 200.8, 6010B, 6020
Manganese	EPA 200.7, 200.8, 6010B, 6020
Mercury	EPA 245.2, 200.8, 7470A, 7471A, 6020
Mercury	EPA 1631E
Molybdenum	EPA 200.7, 200.8, 6010B, 6020
Nickel	EPA 200.7, 200.8, 6010B, 6020
Potassium	EPA 200.7, 200.8, 6010B, 6020
Selenium	EPA 200.7, 200.8, 6010B, 6020
Silicon	EPA 200.7, 200.8, 6020
Silver	EPA 200.7, 200.8, 6010B, 6020
Sodium	EPA 200.7, 200.8
Thallium	EPA 200.7, 200.8, 6010B, 6020
Tin	EPA 200.7, 200.8, 6010B, 6020
Vanadium	EPA 200.7, 200.8, 6010B, 6020
Zinc	EPA 200.7, 200.8, 6010B, 6020
Volatiles	EPA 624, 8260B
Base/Neutral & Acids	EPA 625, 8270C
Cyanide Total	SM 4500-CN^-C, EPA 9010B,9014
Cyanide Amenable to Chlorination	SM 4500-CN^-G, EPA 9010B,9014
pH	SM 4500-H+B, EPA 9040B, 9045C
Oil & Grease	EPA 1664A, AR OG
Phenolics	EPA 420.1, 9065
Specific Conductance	EPA 120.1, 9050A. SM2510B
Total Organic Halides	SM 5320B, EPA 9020B
BTEX	EPA 624, 8260B, 602, 8021
Phenols	EPA 625, 8270C, 604, 8041
Pesticides	EPA 608, 8081A
Polynuclear Aromatic Hydrocarbons	EPA 625, 8270C, 610, 8100
Chlorinated Herbicides	EPA 8151A, 8321A
Toxicity Characteristic Leaching Procedure	EPA 1311
Ignitability	EPA 1010
Corrosivity	EPA 1110
Purge and Trap	EPA 5030B
Separatory Funnel Extraction	EPA 3510C
Organics by GC	EPA 8015B
Metal Digestions	EPA 3010A, 3005A,3051

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Parameter	Method
Ultrasonic Extraction	EPA 3550B
Total Petroleum Hydrocarbons	EPA 1664A, AR TPH
Diesel Range Organics	EPA 3510C, 8015B, DRO.OK
Gasoline Range Organics	EPA 5030B, 8015B, GRO.OK
Acid-Base Partition Cleanup	EPA 3650B
Silica Gel Cleanup	EPA 3630C
Florisil Cleanup	EPA 3550B
Salinity	SM 2520B
Total Dissolved Solids	SM 2540C
Total Suspended Solids	SM 2540D, USGS 3765
Total Solids	SM 2540B
Volatile Solids	SM 2540E
Settleable Solids	SM 2540F
Odor	SM 2150B
Turbidity	EPA 180.1
MBAS	SM 5540C
Total Residual Chlorine	SM 4500-Cl G
PCB	EPA 8082, 600/481/045
Color	SM 2120 B
Temperature	SM 2550B

11.8 Method Development

The methods presented are performed by American Interplex Corporation to meet regulatory requirements and the needs of our clients. This list does not incorporate all the regulatory methodologies available but rather a selected group of methods that an initial and on-going demonstration of capabilities has been demonstrated.

Review, development and inclusion of analytical methodologies other than those listed are dependent upon updated regulatory requirements, technological advancement, and project specific/client requested. All analytical methods used for regulatory compliance must meet initial and on-going demonstration of capabilities as defined in the methodology to confirm its fitness for use.

In the event, no standard analytical methodology is available, AIC may at a clients request initiate method development for the analyte of interest. Initial method validation to determine reporting levels and to assess its fitness for use will be established by analysis of laboratory blanks, laboratory control samples, and matrix spiked samples. The final report to the client will indicated the results of the quality control samples so an assessment of its suitability for the client can be determined.

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12.0 STANDARD OPERATING PROCEDURES

The formal structure of our Quality Assurance Program is contained in a set of Standard Operating Procedures (SOPs), through which each specific topic is detailed individually. American Interplex Corporation has structured our SOPs along the guidelines and constraints of approved EPA methodology. Copies of these SOPs have been provided to Laboratory Managers and are available to all laboratory personnel. Strict adherence to the correct procedure is required and documented in each of the SOPs, which are continually monitored and updated as changes or new developments occur. The following describes our current SOPs.

12.1 Operational Requirements

12.1.1 SOP WATER

Laboratory Pure Water Supply. Type IV deionized water and Type I water are available in the laboratory. This SOP describes the difference in the usage of the two and maintenance requirements.

12.1.2 SOP FIELD

Field Sample Collection. All data must be traceable back to the representativeness of the sample analyzed. This written sampling procedure and along with other supporting SOPs (Sample, DO, pH, etc.) describe the methods of sample collections, preservation, on-site measurements, and Chain of Custody documentation.

12.1.3 SOP BOTTLES

Sample Bottles and Preservation. This describes the process for cleaning sample bottles and the technique for chemical preservation additions.

12.1.4 SOP SAMPLE

Sample Handling and Documentation. Unique sample identification is assigned immediately upon receipt at the laboratory. The process of logging-in and distribution is described in this SOP, which also details sample containers and storage.

12.1.5 SOP STDREAG

Standards and Chemical Reagents. Standards and reagents prepared in the laboratory are logged and assigned an identification number for the purpose of inventory and traceability.

12.1.6 SOP WEIGHT

Weighing Instruments. Analytical balances are used throughout the laboratory. This SOP de-

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scribes the proper procedure of daily calibration and recordkeeping.

12.1.7 **SOP GLASS**

Glassware. The accurate measurement of trace levels of pollutants requires clean and calibrated volumetric glassware. This SOP describes the procedure of cleaning techniques for different types of glassware used for special parameters.

12.1.8 **SOP SOP**

Standard Operating Procedures (SOP). This SOP describes SOP preparation and formatting. AIC policy manuals for QA/QC and Safety will serve as a primary reference in SOPs preparation to prevent the necessity of updating multiple documents.

12.1.9 **SOP INCUB**

Incubators, Refrigerators, and Ovens. All temperature controlled devices are monitored to insure proper storage temperature. The calibration of thermometers for the accurate measurement of temperature required in the proper analysis of parameters is clearly described in this procedure.

12.1.10 **SOP CALC**

Defines the calculations performed for various analyses throughout the laboratory.

12.1.11 **SOP DOC**

The objectives this document are as follows: to provide a standardized, written program of policies, procedures and instructions; to demonstrate that adequate quality assurance and quality control procedures have been implemented; to demonstrate that accountability of the data is maintained; and to ensure traceability of analytical results.

12.1.12 **SOP PDF**

This SOP details the procedure for scanning and transmitting a report via the Internet as a PDF file.

12.2 Instrumental Requirements

The instrument manufacturers manual located in the laboratories serve as the definitive source for instrument set-up, analysis, software requirements and programming, as well as that of maintenance procedures. The instrument(s) performance must meet the method criteria defined in the analytical methodology for which it is utilized.

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12.3 Biomonitoring Requirements

Chronic tests follow the guidelines set forth in *EPA 821-R-02-013 Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (Fourth Edition, October 2002)* for Methods 1000 and 1002. Acute tests follow the guidelines set forth in *EPA 821-R-02-012 Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fifth Edition, October 2002)* for Methods 2000, 2002, and 2021.

The following is a list of Standard Operating Procedures for Biomonitoring procedures. These SOPs comply with EPA protocols, state, and federal regulatory agency requirements. Specific information concerning filtered air, light cycles, and laboratory apparatus are addressed.

SOP 24CD	24-Hr Acute Toxicity Test, *Ceriodaphnia dubia*
SOP 24DP	24-Hr Acute Toxicity Test, *Daphnia pulex*
SOP 24PP	24-Hr Acute Toxicity Test, *Pimephales promelas*
SOP 48CD	48-Hr Acute Toxicity Test, *Ceriodaphnia dubia*
SOP 48DP	48-Hr Acute Toxicity Test, *Daphnia pulex*
SOP 48PP	48-Hr Acute Toxicity Test, *Pimephales promelas*
SOP 7CD	7-Day Static Renewal Survival and Reproduction Test, *Ceriodaphnia dubia*
SOP 7FH	7-Day Static Renewal Survival and Growth Test, Larval Fathead Minnow, *Pimephales promelas*
SOP EMBRYO	The Culture of *Pimephales promelas*
SOP BIOCULT	The Culture of Cladoceran, *Ceriodaphnia dubia*
SOP DPCULT	The Culture of *Daphnia pulex*
SOP BIOALG	*Selenastrum capricornutum* Algal Cultures
SOP BIOSYN	Preparation of Synthetic Water
SOP SHRIMP	The Culture of Brine Shrimp, *Artemia spp.*
SOP BIOYCT	Preparation of YCT for Feeding *Ceriodaphnia dubia* and *Daphnia pulex*
SOP BIOGLASS	Glassware cleaning for Biomonitoring

12.4 Traceability of Measurement

The record keeping system must allow historical reconstruction of all laboratory activities that produced the resultant data. The history of the sample must be readily understood through the documentation.

- The records shall include the identify of personnel involved in sampling, preparation, calibration, or testing
- All information relating to the laboratory facilities, equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification must be documented
- All working files, electronic files, and archived records must be easily retrieved for inspection and verification purposes

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- All documentation entries shall be signed or initialed by responsible staff. The reason for the signature or initials shall be clearly indicated in the records such as "sampled by", "prepared by", or "reviewed by"

- All data generated, except those that are generated by automated data collection systems, shall be recorded directly, promptly and legibly in permanent ink

- Entries in records shall not be obliterated by methods such as erasures, overwritten files, or marking. All correction to record-keeping errors shall be made by one line marked through the error. The individual making the corrections shall sign (or initial) and date the correction. These criteria also shall apply to electronically maintained records

- All records (including those pertaining to calibration and test equipment), certificates, and reports shall be safely stored, held secure, and in confidence to the client

- All records shall be maintained for ten years. Records which are stored on electronic media must be supported by the hardware and software necessary for their retrieval

- Raw data records for the Laboratory consist of parameter logbooks, personal logbooks, and computer generated data files

In general, the records throughout the laboratory are archived in the same manner. When sufficient files are acquired, they are transferred to a storage box, the box content is noted, and an archival storage number is assigned. Access to archived information shall be documented by an access log. Files are stored in a locked, secured area.

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13.0 CALIBRATION

Inclusion of standards in analytical methods is necessary to quantitate the amount of analytes present in the sample. Calibration is used to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. It establishes a reproducible reference point to which all sample measurements can be correlated.

13.1 Standards

A set of standards will be analyzed to establish calibration for each analytical method. In addition, a check standard shall be analyzed every 10 samples and at the end of the analysis. This standard is necessary to verify the standard curve and may serve in some cases as sufficient for calibration. These values should be documented in the instrument calibration log whenever performed.

13.1.1 **Traceability of Standards**

All inorganic and organic standards utilized for instrumentation/methodological calibration and preparation of quality control check samples shall be traceable. Primary standards are obtained from a reliable, certifiable source and are of the highest possible purity. Standards are purchased from commercial vendors such as Chem Service, Inc., Fisher Scientific, Supelco, etc. for use in all laboratory analyses. As each chemical is received, it is assigned a unique Chemical Number through LIMS' purchasing and receiving. The chemical container and all associated documentation are labeled with this number. In 2006, AIC's LIMS system was programmed to serves as an electronic record of usage and tracebility of chemicals. The chemical number is referenced in either the laboratory logbooks, LIMs and/or the standard reagent logbooks. Information concerning sources, certification numbers, date received, and quantity received is available by referencing the assigned chemical number and its file documentation.

All standards must be stored under proper conditions and in containers that provide the greatest protection against deterioration and/or contamination.

Stock and working standards solutions must be prepared as often as required by their stability and as stipulated in the method. Standards will be checked regularly for signs of deterioration (i.e., discoloration, formation of precipitates, and changes in concentration). Standard solutions will be properly labeled as to compound name, concentration, solvent, date, and analyst as noted in SOP STDREAG.

13.1.2 **Definitions of Standards**

Primary compound is a liquid or solid compound in a pure form obtained from a commercial distributor.

Stock standard is a standard prepared or obtained from the primary compound (i.e., liquid or solid) at a high concentration.

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Working standard is a standard used in the quantitation and calibration of the compounds of interest.

13.1.3 **Expiration of Standards**

Standards purchased from commercial sources, as well as those from EPA or NIST, are dated upon receipt. Date of expiration will also be noted if available. A standards' expiration date supplied by the manufacturer will be used as a frame of reference for replacement. Extension of the manufacturer's expiration date as a replacement date is contingent upon stability of the analyte and the ability of the laboratory to re-certify the analyte. Standards and spiking solutions can be re-certified with an extended shelf-life only if it is evaluated against a standard prepared from a different source such as an un-expired Initial Calibration Standard, Laboratory Control Sample, and/or standardized by comparison to a primary compound. The acceptance criteria must meet initial calibration for the definitive method. For stock standard solutions and working standards prepared in the laboratory, a 6-month shelf life is assigned for evaluation and preparation unless the definitive method specifies differently.

The laboratory shall retain records for all standards, reagents, reference materials and media including the manufacturer/vendor, the manufacturer's Certificate of Analysis or purity (if supplied), the date of receipt, recommended storage conditions (defined by the manufacture or methodology), an expiration date after which the material shall not be used unless its reliability is verified (and traceable) by the laboratory. Documentation of the standard, reagent preparation is maintained in LIMs. LIMs maintains documentation from chemical/reagent receipt to preparation prohibiting the use of expired standards. If the standards are re-certified, LIMs provides through programming, assurance that an expired standard cannot inadvertently be used in preparation of a curve or used in re-certification of standards or spiking solutions. Where applicable, the laboratory control sample (LCS) or an independent check traceable standard will be used to monitor standard degradation. Results of the LCS or the check standard will be compared against the given target range values and in some instances serve to validate an expired standard.

Original containers for standards (such as provided by the manufacture or vendor) shall be labeled with an expiration date/evaluation date..

Records shall be maintained on standard and reference material preparation. These records shall indicate traceability to purchased stocks or neat compounds, reference to the method of preparation, date of preparation, expiration date and analyst initials/number identification. In addition, standards prepared as stock or working standards will be properly labeled to include name of compound mixture, concentration, solvent/medium, date, standard/reagent number.

13.2 Calibration Requirements

Calibration is the set of operations, which establishes, under specified conditions, the relationship between values indicated by measuring the instrument and the corresponding known values of a standard. The result of the calibration shall be expressed as a calibration factor in the form of a calibration curve (i.e., linear regression) or as a response factor to be utilized in the qualification and quantitation of data.

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Requirements for satisfactory instrument calibration have been established to ensure that the instrument is capable of producing acceptable data.

13.2.1 **Initial Calibration**(NELAC)

This section specifies the essential elements that shall define the procedures and documentation for initial instrument calibration and continuing calibration verification to ensure that the data must be of known quality and be appropriate for a given regulation or decision. The following items are essential elements of initial instrument calibration:

13.2.1.1 The details of the initial instrument calibration procedures including calculations, integrations, acceptance criteria and associated statistics are to be included or referenced in the test method SOP and available for review. (NELAC)

13.2.1.2 Raw data records must be retained to permit reconstruction of the initial instrument calibration, calibration date, test method, instrument, analysis date, each analyte name, analyst initials and number or signature, concentration and response, calibration curve or response factor; or unique equation or coefficient used to reduce instrument response to concentration. This information shall be maintained in one or more of the following ways: in a written hardcopy, electronic printout, or electronically. (NELAC)

13.2.1.3 Sample results must be quantitated from the initial instrument calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, reference method, or program. (NELAC)

13.2.1.4 All initial instrument calibrations must be verified with a standard obtained from a second manufacturer or lot if the lot can be demonstrated from the manufacturer as prepared independently from other lots. Traceability shall be to a national standard, when commercially available. (NELAC)

13.2.1.5 Criteria for the acceptance of an initial instrument calibration must be established, e.g., correlation coefficient or relative percent difference. The criteria used must be appropriate to the calibration technique employed. (NELAC)

13.2.1.6 The lowest calibration standard shall be the lowest concentration for which quantitative data are to be reported. Any data reported below the lower limit of quantitation should be considered to an increased quantitative uncertainty and shall be reported using defined qualifiers or flags or explained in the case narrative. (NELAC)

13.2.1.7 The highest calibration standard shall be the highest concentration for which quantitative data are to be reported. Samples shall be diluted and analyzed within the linear range of the curve. If dilution is not an available option, any data reported above this high standard should be considered to have an increased quantitative uncertainty and shall be reported using defined qualifiers or flags or explained in the case narrative. (NELAC)

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13.2.1.8 Measured concentrations outside the working range shall be reported as having less certainty and shall be reported using defined qualifiers or flags or explained in the case narrative. The lowest calibration standard must be above the limit of detection. Noted exception: The following shall occur for instrument technology (such as ICP or ICP/MS) with validated techniques from manufacturers or methods employing standardization with a zero point and a single point calibration standard. (NELAC)

13.2.1.8.1 Prior to the analysis of samples the zero point and single point calibration must be analyzed and the linear range of the instrument must be established by analyzing a series of standards, one of which must be at the lowest quantitation level. Sample results within the established linear range will not require data qualifier flags.

13.2.1.8.2 Zero point and single point calibration standard must be analyzed with each analytical batch.

13.2.1.8.3 A standard corresponding to the limit of quantitation must be analyzed with each analytical batch and must be established acceptance criteria.

13.2.1.8.4 The linearity is verified at a frequency established by the method and/or the manufacturer.

13.2.1.9 If the initial instrument calibration results are outside of established acceptance criteria, corrective actions must be performed and all associated samples re-analyzed. If reanalysis of the samples is not possible data associated with an unacceptable initial calibration instrument calibration shall be reported with appropriate data qualifiers.

13.2.1.10 If a reference method does not specify the number of calibration standards the minimum is five (one of which must be at the limit to quantitation/reporting limit) not including blanks or a zero standard with the exception of instruments technology for which it has been established by the methodologies and procedures that a zero and a single calibration point standards are appropriate for calibrations.

13.2.2 **Continuing Calibration Requirements (NELAC)**

When an initial instrument calibration is not performed on the day of analysis, the validity of the initial calibration shall be verified prior to sample analyses by continuing instrument calibration verification with each analytical batch. Essential elements of the continuing instrument calibration verification are:

13.2.2.1 Calibration shall be verified for each compound, element, or other discrete chemical species, except for multi-component analytes such as Aroclors, Total Petroleum Hydrocarbons, or Toxaphene where a representative chemical related substance or mixture can be used.

13.2.2.2 Instrument calibration must be performed at the beginning and end of each analytical batch (except, if an internal standard is used, only one verification needs to be performed at the beginning of the analytical batch.

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13.2.2.3 Instrument calibration verification must be performed whenever it is expected that the analytical system may be out of calibration or might not meet the verification criteria.

13.2.2.4 Instrument calibration must be performed if the time period for calibration or the most previous calibration has expired.

13.2.2.5 Instrument calibration verification must be performed for analytical systems that contain a calibration verification requirement.

13.2.2.6 Sufficient raw data records must be retained to permit reconstruction of the continuing instrument calibration, e.g., test method, instrument, analysis date, each analyte, concentration and response, calibration curve or response factor, or any unique equations or coefficients used to convert instrument responses into concentrations. Continuing calibration verification records must explicitly connect the continuing verification cata to the initial instrument calibration.

13.2.2.7 Criteria for the acceptance of a continuing instrument calibration must be established, e.g., relative percent difference. If the continuing calibration verification results obtained are outside established acceptance criteria, corrective action must be performed and documented. If routine corrective action procedures fail to produce a second consecutive (immediate) calibration verification within acceptance criteria, then a new initial instrument calibration must be performed. If calibration has not been verified, sample analyses may not occur until the analytical system is calibration or calibration verified.

13.3 Instruments – Instrument calibration must meet the criteria as defined in 13.2.

13.3.1 **UV/VIS Spectrophotometers**

Spectrophotometers are calibrated for each analyte prior to any sample analysis using linear regression/ regression equation. A minimum of five (5) concentrations, unless specified differently in the method, will be used for quantitation. A calibration blank is analyzed, however, linearity through zero is a statistical assumption and can result in the reporting of results below the calibration range. The calibration blank is not included in the calibration. An acceptable initial calibration is a correlation coefficient greater than or equal to 0.995. In addition, a check standard shall be analyzed every 10 samples and at the end of the analysis. The check standard will verify the standard curve and will serve in some cases as sufficient for calibration.

Standard procedure is for the absorbance values to be entered into the linear regression line, and a % Difference for each calibration standard is calculated. The % Difference must be less than 30% for standards at or near the detection limit or limit of linearity and less than 15% for standards at the mid-range of the curve. If not, evaluation and recalibration is performed as necessary.

Absorption cells are to be kept clean and free of scratches and fingerprints and are rinsed with the solution to be analyzed before use. Cells are matched by placing portions of a solution in both cells and tak-

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ing several readings of the absorbance.

13.2.2 **Spectrometers**

Instruments must be calibrated daily. The calibration requirements and acceptance criteria for the spectrophotometers is detailed in the standard operating procedures for the methods. Refer to SOP ICPMS, ICP, HG, and TJA for specific details.

For Atomic Absorption (AA) instruments, a blank and at least three standards must be used in establishing the analytical linearity. The lowest calibration standard must be no greater than 2 to 5 times the Instrument Detection Limit (IDL). The correlation coefficient for all curve standards must be greater than or equal to 0.998.

For ICP-AES instruments, a blank and at least one standard must be used. For ICPMS, a Daily Instrument Check solution shall be analyzed. The results for Rhodium must be > 250,000 counts and double charged ions and oxides must be <3%.

Internal standardization is used for all ICPMS analyses to correct for instrument drift and physical interferences. The absolute response of any one internal standard must not deviate more than 70-120% of the original response in the calibration blank. If deviations greater than these are observed, the sample concentrations are evaluated, the samples are then either diluted, re-analyzed without dilutions, or evaluated against a different internal standard..

For all instruments, an Initial Calibration Verification (ICV) must be performed using EPA or other certified source standards. The ICV standard is not digested and must be analyzed with each calibration for verification. When measurements exceed the control limits or the target ranges supplied by the vendor, the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.

If the ICV is not available or if a certified solution of an analyte is not available, analysis shall be conducted on an independent standard at a concentration other than that used for the calibration but within the calibration range.

An Initial Calibration Blank (ICB) must be analyzed at the beginning. Continuing Calibration Blank (CCB) is analyzed at a frequency of 10% and at the end of the analysis run.

A Continuing Calibration Verification (CCV) must be performed for each analyte at a frequency of 10% and also at the beginning and at the end of the analysis. The concentration of the CCV should be near the mid-range of the calibration curve. Value obtained must be within 10% of the expected level.

The Interference Check Sample (ICS) is used to verify inter-element and background correction factors on the simultaneous ICP. It is analyzed at the beginning and the end of each sample analysis run, a minimum of two (2) times for every eight (8) hours. Results must fall within the control limits of +/- 20% of the true value for the analytes included in the ICS. If not within the control limits, the analysis is

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terminated, the problem corrected, the instrument recalibrated, and the samples re-analyzed.

If interference cannot be resolved successfully, two options are available for resolution: samples will be analyzed on sequential ICP at either the same or an alternate wavelength to eliminate interference or a standard addition technique may be employed.

13.3.3 Gas Chromatographs (GC)

Calibration curves for GCs must be composed of three to five standards based upon the analytical method requested. Calibration standards must include concentrations at or below the regulatory limit/decision level. The lowest standard concentration shall be approximately three (3) times the limit of detection and defines the reporting limit for which quantifiable data can be reported. The upper level of linearity of the curve shall be determined. The range of standard concentrations will be based upon the range of linearity, column capacity, and detector capabilities.

Linearity of the instrument must be checked by calculating the Relative Standard Deviations (RSDs) for the compounds of interest. The Relative Standard Deviation of the Response Factor (RF) must be consistent with RSDs (<10% for EPA 600s, <20% for EPA 8000s) specified by the method. Alternately, linear regression shall be used for calibration. The requirement for an acceptable initial calibration is a correlation coefficient equal to or greater than 0.995.

The calibration curve or Response Factor is verified by the analysis of initial calibration verification standard obtained from a second manufacturer or lot if the lot can be demonstrated as prepared independently from other lots. The initial calibration must be within +/- 25% of the concentration. A continuing calibration check standard prepared from the same source as the standards is analyzed at the beginning, every ten samples, and at the end of each analytical batch. The concentration of the calibration verification shall be varied within the established calibration range. If internal standards are used, only one continuing instrument calibration verification must be analyzed per analytical batch.

The % Difference must be consistent with the acceptance criteria as defined in the method. If linear regression is employed, the continuing calibration check standards must have a % Difference of less than 15% for standards in the mid-point of the curve. If the continuing calibration verification results obtained are outside established acceptance criteria, corrective actions must be taken.

A solvent blank, which matches the solvent used in the preparation of the sample for analysis, is analyzed after a standard or after a contaminated sample to check for carry-over contamination.

13.3.4 Gas Chromatographs/Mass Spectrometers (GC/MS)

Procedures for calibration and instrument tuning for sensitivity and selectivity by the mass spectrometers are dependent upon the instrument's ability to sense a change in charge with reference to the mass of the compound.

Calibration curves for volatiles and semi-volatiles analyses consist of a five (5)-point calibration curve.

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Concentrations of the calibration curve standards are specified or defined by the method. To each calibration standard, a known constant amount of one or more internal standards is added. Calibration of the GC/MS is established and validated by the injection of traceable standards at levels over the range of expected sample concentrations. In addition to surrogate recovery compounds, sample extracts are spiked with an internal calibration standard that spans the retention time range of the analytes of interest. The concentrations of the analytes are calculated by the Response Factor (RF) to the internal standards for each sample.

Analysis of Bromofluorobenzene (BFB) for volatiles and Decafluorotriphenylphosphine (DFTPP) for semi-volatiles is performed every twelve (12) hours during sample analysis. The tuning acceptance criteria must be met before the analysis of the calibration curve standard or the calibration check standard can begin. Calculations of response factor, relative standard deviation, internal standard, or the calibration factor must be less than the method requirements.

A system performance check must be performed to ensure that minimum average RFs are met before the calibration curve is used. The minimum acceptable average RF for the System Performance Check Compounds (SPCCs) is 0.050.

The working calibration curve must be verified every twelve (12) hours by the injection of one or more calibration check compounds (CCC). If the response for any analytes varies from the predicted response as specified in the method requirements, the analysis is terminated, the problem corrected, the instrument recalibrated, and the samples re-analyzed.

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14.0 INTERNAL AND EXTERNAL QUALITY CONTROL CHECKS

Assurance of quality analytical results is achieved by applying the following techniques to all analytical methods, which lend themselves to this consideration. American Interplex Corporation prepares a Method Blank, a Laboratory Control Sample (LCS), Matrix Spike (MS)/Matrix Spike duplicate and/or a sample duplicate or Laboratory Control Sample Duplicate for each preparation run of up to 20 samples of similar matrix for parameters which lend themselves to these tests.

14.1 Blank Analysis

Blanks are to be included in analytical methods. A blank is characterized as a sample included in the analytical process, which has the same properties of the actual sample except that it does not contain the substance of interest. It could be necessary to create a blank, which replicates the samples in terms of salt content or any other variable. Blanks will be subjected to reagent additions and other treatments that the samples receive during analysis. The results of the blank are used to assess the batch. The source of blank contamination must be investigated and measures taken to correct, minimize or eliminate the problem. The blank contamination must not exceeds a concentration greater than 1/10 of the measured concentration of any sample in the associated sample batch, nor can the blank contamination exceed the concentration present in the samples or be greater than 1/10 of the specified regulatory limit. Any sample associated with the contaminated blank shall be reprocessed for analysis, except when the sample analysis resulted in non-detect. If no sample volume remains for reprocessing, the results shall be reported with appropriate data qualifying codes.

14.2 Duplicate Analysis

Duplicate sample analysis is the analysis of the same sample twice to determine the precision of the analysis. The relative percent difference between the two determinations will be calculated and compared to method defined limit or historical data.

14.3 Spike Analysis

Spiked samples are samples fortified with a known amount of target analyte and then subjected to the entire analytical procedure. The recovery of the method will be calculated for accuracy. The acceptance criteria is based on defined method limits or past information generated. A matrix spike duplicate can also be analyzed to yield duplicate or precision information about the analysis as well.

14.4 Audits

In order to verify that a laboratory possesses the capability to provide accurate and reliable test data in its day-to-day operations, an audit of the laboratory is conducted. There are several types of audits. These are internal, where the laboratory reviews and examines itself, or external, where the laboratory is audited by outside organizations, such as an accrediting or regulatory agency or clients. American Interplex Corporation has actively sought certification and accreditation by organizations offering it in those

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areas relevant to our technical expertise. These external audits are usually announced inspections but sometimes are conducted without forewarning. The Laboratory Director usually accompanies such audit teams through the lab. The auditor receives a brief overview of company objectives, activities, and facilities. Interviews with technical staff are arranged, along with retrieval of any documentation pertinent to the audit. Auditors typically provide an account of their findings in a close out interview with laboratory management. This account is evaluated and recommendations for action in response to any cited deficiencies are addressed. The findings of all audits, as well as the laboratory response and any corrective actions are documented. Follow-up checks are performed and the status of implementation of corrective actions is documented for all categories of audits and assessments. This cycle continues until all issues are closed.

14.4.1 **Internal Audits** are performed to assess the degree of adherence to established policies, procedures, and standards. These audits are conducted by personnel who are independent of the area being evaluated. Audits can identify areas for improvement with regard to compliance with policies, procedures, and standards. Audits also provide a means for correction prior to system failure. These audits consist of real-time inspections of the analytical process, comparing the daily operations to applicable SOPs and policies. Formal inspection records detailing the extent of the inspection are issued and any non-conformance issues are noted. During an audit, verification shall be sought to ensure the following:

14.4.1.1 Standard Operating Procedures (SOPs) are followed and analysts understand them
14.4.1.2 Analytical practices performed in the laboratory are consistent with SOPs
14.4.1.3 Adequate quality control practices are applied during production
14.4.1.4 Analytical data calculations and data entry are correct
14.4.1.5 Data criteria of accuracy, precision, completeness, representativeness, and comparability is met
14.4.1.6 Instrument logs, laboratory notebooks, and analytical records are properly maintained
14.4.1.7 Corrective actions are addressed, and an appropriate response was determined
14.4.1.8 Personnel training records, performance test results, and analysts' performance is satisfactory and current.

14.4.2 **External Audits** are performed when certifying agencies or clients submit samples for analysis or conduct on-site inspections. It is AIC policy to cooperate fully with auditors.

14.4.2.1 AIC is involved in external performance audits conducted semi-annually (water and soil) through the analysis of Performance Evaluation (PE) samples provided by a third party.
14.4.2.2 It is recognized that PE samples are not often representative of "real world" samples either in their form (e.g. vials), content (e.g. multiple target analyte hits), or documentation (no chain of custody) and as such by their nature present the laboratory with exceptions to AIC's standard operating procedures.
14.4.2.3 It is AIC's and NELAC's policy that PE samples be treated as typical samples in the normal production process where this is possible. Further, where PE samples present special or unique problems in the normal production process they need to be treated differently, as would any special or unique request submitted by any client.

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14.4.2.4 Holding times begin when the vial is opened. Full volume PTs follow normal hold time procedures and storage requirements.

14.4.2.5 Login will forward PE samples to Director of Quality Assurance or other designated staff for review.

14.4.2.6 Vials will be prepared as required in the instruction set provided with the samples. After preparation to full volume the sample may be spiked, digested, concentrate, etc., as would be done for any normal sample requiring similar analysis.

14.4.2.7 PE samples will not undergo multiple preps, multiple runs, multiple methods (unless being used to evaluated multiple methods), multiple dilutions, unless this is necessary for quantitation of the data. PE samples are often multi-analyte and of various concentrations and may exceed the linear range for one or more analyte of interest. Sample dilutions would be appropriate.

14.4.2.8 No special reviews shall be performed by operation and QA, unless this is what would be done to a normal client sample. To the degree that special report forms and e-mailing procedures are required by the PE supplier, it is reasonable that the laboratory would apply special review procedures, as would be done for any client requesting unusual reporting or login processes.

14.4.2.9 NELAC requires that whenever a laboratory fails a study, it shall determine the root cause for the failure and take any necessary corrective action. If a laboratory fails two out of the three most recent studies for a given PE field of testing, its performance is considered unacceptable under the NELAC PET standard for that field. The lab shall then need to meet the requirements of initial accreditation as described in NELAC 2003 Standard. For initial studies, the PE studies shall be at least 15 days apart from the closing date of one study to the opening date of the next study. The laboratory must successfully complete two PE studies for each requested PE field of testing within the most recent three rounds attempted.

14.4.3 Considering Confidential Business Information, during on-site audits, on-site auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on the information at the time it is submitted to the auditor a cover sheet, stamped or typed legend, or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential." These documents may be purged of reference to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information.

14.4.4 **System Audits** are comprehensive technical and systems evaluations covering each operational and support area at least once per year. The systems audits are performed on a rotating schedule that is established throughout the year. The schedule may change as situations in the laboratory warrant. The objectives and schedule of the audits are communicated to the laboratory groups being assessed in advance of the audit. At the completion of the audit, a debriefing is held to outline the findings, including identification of positive performances, to discuss areas of deficiencies, and to provide for questions and

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response from all parties involved. A written audit report will be provided with 14 calendar days of the date of the audit report. The audit response from the laboratory areas must the follow the original audit report and provided to all individuals involved. Where a corrective action and preventative action report is generated the response must detail an investigative, implementation plan, and target date of completion.

14.4.5 **Data Audits** are routinely performed and documented to ensure that project records meet project requirements as described in method SOPs, project plans, or other documented requirements. The data audit is used to identify any laboratory errors that may have occurred. Significant issues found in the course of the audit are brought to the attention of appropriate personnel for clarification and overseeing correction of final reports if necessary. At a minimum one report per analyst per year will be performed. Data audits include spot-checking of manual integrations to determine if they are appropriate and documented. Errors found in client reports are revised and the revisions sent to the clients.

14.4.6 **Spot Assessments** are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, data assessment concerns, corrective actions, control charts, proficiency testing results, data audits, or external audit issues. Spot assessments are focused on a specific issue. The frequency, report format, distribution, and time frames are tailored to address the nature of the issue.

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14.4.7 **Audit Frequency**

Audit Type	Performed By	Frequency
System Audits	Director of Quality Assurance	Annual/Laboratory Dept.
Data Audits	Director of Quality Assurance	One data package/analyst or analyst group/year
Spot Assessment	DQA or designee	As needed to monitor specific issues
Proficiency Testing	Coordinated by DQA	Two samples/year/program DMRQA Study As needed to assess laboratory/ analyst performance

14.4.8

Number of Audits Required (Semi-annually)	Audit Description	
2	Standards/Reagents	Properly Labeled LIMS Use Certifications/Traceable
2	Maintenance Log	Documentation Service
1	SOP	Current Testing Audited Standards Audited
2	Thermometers	Logs us to Date
1	Archive Procedures	Hard Copies System Back-ups
2	Training Records	Training Log PE Samples SOP Test Demonstration of Capability
3	Sequence Logs	Proper QC Frequency
2	Review Procedures	Corrective Action Forms GALP Notebooks Reviewed and signed off Manual Integration Documented Manual Integration Reviewed on Screen.

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2	MDLS/PQLS	All instruments current Lowest Standard Reporting Limit
2	SMG	Matrix Specific Procedures pH Checks Documentation Procedures Temperature Checks
1 Review per/method Type*	Method Audit	Review SOP Review RM Review Worksheets Review Quality System

*Volatiles, GC, GC/MS; Semivolatiles GC/MS; HPLC;Organic Preparation; Metal Preparation; Mercury Method; Gravimetric Method; Titrimetric Method; Spectrophotometric; Electrometric; IC; TCLP

14.5 Quality Control Check Analysis

14.5.1 **Laboratory Control Samples (LCS)** contain a known amount of target analyte. They are prepared in the laboratory or obtained from a source other than the standards used for calibration. This accuracy information is valuable because variables specific to sample matrix are eliminated, and it ensures the correctness of the analysis.

14.5.2 **Internal Audit Samples** are similar to Laboratory Control samples except that the true value of the target analyte is not known to the analyst. These types of samples may be purchased or prepared by the Director of Quality Assurance or the Laboratory Manager.

14.5.3 **External Performance Evaluation Samples** are often referred to as proficiency test samples and used for laboratory certification by various regulatory agencies. Proficiency test samples are analyzed every six months, with the laboratory participating in at least two studies per year for four (4) analytical results per analyte. The samples are supplied and the results submitted to an outside regulatory-approved source. During the submittal process, American Interplex Corporation authorizes the proficiency test provider to release the results to designated agencies. For all these agencies, AIC is required to respond to any "unacceptable" test results. In some cases, AIC will be required to analyze additional proficiency samples for the failed parameter.

14.5.4 **Reference Toxicants** are performed routinely to validate Biomonitoring test organism sensitivity. If reference toxicant test results are outside of expected ranges, the tests initiated with substandard organisms are of suspected quality. Testing conditions and methods are identical to those used in compliance testing.

- Acute reference toxicant tests are performed monthly. Test organisms are subjected to a 48-hour non-renewal reference toxicant, Sodium Chloride (NaCl), to evaluate the organism's sensitivity.

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- Chronic reference toxicant tests are performed monthly. Two (2) stock solutions of Sodium Chloride (NaCl) are utilized; one solution is for the fathead minnows, and one for test for the *Ceriodaphnia dubia.* The reference test is performed exactly as an effluent test. Termination of the Pimphales promelas Survival and Growth Test is 7 days. The Cladoceran, *Ceriodaphnia dubia* Survival and Reproduction Test terminates after 60% of the surviving control organisms have three broods of offspring with an average of 15 neonates per surviving female.

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15.0 DATA ASSESSMENT AND VALIDATION

Data assessment and validation incorporate a variety of techniques to evaluate the quality of the measurement process and the data generated. Parameters of major importance are precision, accuracy, completeness, representativeness, and comparability.

15.1 Precision

The laboratory uses duplicate analysis of samples, matrix spikes, and matrix spike duplicates to assess precision and accuracy. A sample duplicate and/or matrix spike duplicate will be analyzed for each 20 samples for in-house QC and are dependent upon the sample matrix and method of analysis. The analytical precision, Relative % Difference (RPD), is expressed as a percentage of the difference between the results of duplicate sample analyses or two matrix spikes for a given analyte. It is calculated as follows:

$$RPD = \frac{(|MS\ Concentration - MS\ Duplicate\ Concentration|)}{Mean\ of\ MS\ and\ MS\ Duplicate\ Concentrations} \times 100$$

MS denotes Matrix Spike.

15.2 Accuracy

The accuracy of measured data is evaluated by the comparison of the percent recovery of the spiked sample analysis and/or Laboratory Control Samples (LCS) of known or established concentrations to control limits. Control limits have been established for each method of analysis and sample matrix. A spike analysis will be performed for a group of 20 samples and is dependent upon the sample matrix, method of analysis, and concentration level. Recoveries will be assessed to determine method efficiency and matrix interference effects.

Analytical accuracy will be expressed as the Percent Recovery of an analyte/parameter, which has been added to the environmental samples at a known concentration before preparation and analysis. The equation used to calculate Percent Recovery (%R) is as follows:

$$\%R = \frac{(Spiked\ Sample\ Concentration - Sample\ Concentration)}{Spike\ Concentration\ Added} \times 100$$

15.3 Completeness

For the data to be valid, it must meet all the acceptance criteria, including accuracy, precision, and any other criteria specified by the analytical method. Data validation procedures are employed to eliminate incorrect data acquired through data collection.

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The specific accuracy and precision level will be dependent upon the type of sample matrix and the analytical method applied. The laboratory's historical statistical control limits and method limits will be used as guidelines to validate the data generated. Completeness of analytical effort can be numerically determined by the following equation:

$$C\% = (V/T) \times 100$$

C = Completeness of Analytical Effort
V = Number of valid samples analyzed
T = Number of samples

15.4 Representativeness

Data generated by the laboratory shall be representative of the overall population of samples collected and analyzed. It shall be representative of the laboratory's database of accuracy and precision measurements for a given parameter, matrix, and analytical method.

15.5 Comparability

Data generated shall be used to evaluate completeness of extensive monitoring programs and testing purposes based on historical data measurements of parameters, matrixes, and analytical methods. Data should be reproducible under similar conditions, whether generated by American Interplex Corporation or another laboratory. Automatically, LIMS will evaluate data from a client's site and notify the Laboratory Director and Director of Quality Assurance that a statistical difference has occurred. The data is than further evaluated and in some instances the result is confirmed prior to releasing the data.

15.6 Uncertainty

Every measurement has error that is ultimately unknown and unknowable. The description of this unknown error is "measurement uncertainty. In most cases American Interplex Corporation (AIC) uses well-recognized test methods which specify limits to major sources of uncertainty (e.g. a balance accurate to $\pm$ 0.001 g) and provide reporting instructions so that the reported data do not give the wrong impression of the uncertainty of the test results. In rare instances, AIC may be requested to provide an estimate of the uncertainty of a test result. In those instances one the following options, with preference given to the first option will be utilized.

15.6.1 Estimation of Uncertainty using Laboratory Control Samples. This method uses the limits of historical LCS data to estimate results to a 99% confidence interval using the following equation:

$$100(c/R)(1 \pm L/R)$$

Where: c = measured concentration of the analyte
R = mean historical Laboratory Control Sample Recovery

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L = the half width of the control range, (CL-LCL)/2

15.6.2 Procedure provided for in Standard Methods 1030B Measurement Uncertainty.

15.7 Control Charts

15.7.1 **Theory of Control Charts**

The performance of a measurement system can best be demonstrated by the measurement of a stable and homogeneous control sample in a planned repetitive process. As the data is transferred to LIMS, LIMS' QC Program will plot and evaluate the measurement process. The laboratory is automatically alerted to any quality control failures.

15.7.2 **Uses of Control Charts**

- Provide graphical representation of accuracy and precision for the analysis of each analyte and instant detection of erroneous data.
- Allow efficient observation of recovery trends for a particular analysis and provide long-term mechanism for self-evaluation of analytical data.
- Provide assessment of analytical capability of the staff chemists with regard to the output of valid analytical data.
- Allow observation of deviations from control trends.

15.7.3 **Types of Control Charts**

- Percent Recovery (%R)
- Relative Percent Difference (RPD)

15.7.4 **Control Chart Preparation**

15.7.4.1 Percent Recovery (%R). The mean and the standard deviation will be calculated. The initial data will be reviewed for outliers. The Grubbs Test for Outlying Observations will be used for making statistical decisions on rejection of suspect data. From this data, the upper and lower control limits and warning limits will be calculated.

Upper Control Limit (UCL) = Mean of %R + 3s

Lower Control Limit (LCL) = Mean of %R - 3s

Warning Limits (WL) = Mean of %R $\pm$ 2s

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s denotes standard deviation

The %R of each laboratory control sample, spike, or matrix spike duplicate will be plotted on a Shewart control chart and compared with method criteria and/or statistically generated control limits.

15.7.4.2 Relative Percent Difference (RPD). Data precision will be evaluated on the results of matrix spike and matrix spike duplicate samples or samples analyzed in duplicates. All analyses which have criteria defined by a recognized source EPA, ASTM, Standard Methods) for Relative Percent Difference will be evaluated against these limits. For those methods in which no performance criteria has been established, the average and standard deviation of the absolute values of the Relative Percent Difference (RPD) will be calculated, and a range chart will be established. The lower control is zero. The upper control limit is calculated as the average RPDs + 3s.

15.7.5 **Interpretation of Control Charts**

The control chart distinguishes between random and assignable causes of variation. Each point on a control chart represents a test of "quality data" hypothesis. Critical to data validation and assessment is a thorough understanding of what constitutes an out-of-control situation. The following criteria will be used to evaluate out-of-control analyses:

- One or more batches outside the control limit (3s)
- A run of two or more consecutive batches outside warning limits (2s)

15.7.6 **Statistical Evaluation of Data Sets**

Evaluation of analytical data is accomplished using statistical tools such as "test of significance". These tests confirm data comparability and representativeness to historical data and to method requirements. The data is looked at critically for errors and consistency by the use of known statistical techniques; such as, "F test", "Chi square", and "Student's t test". Questions on whether data sets are peers or from a different population are answered. The appropriate computations for combining data sets to obtain a better estimate of standard deviation of a population means are utilized.

Reference toxicant data for Biomonitoring Analyses is analyzed monthly and evaluated using point estimate analysis to establish calculated effect concentrations for trending observations. Trends in organism sensitivity can then be addressed through documentation of laboratory procedures and analyst's technique. Chronic survival data for both fathead minnow and *Ceriodaphnia dubia* test organisms is analyzed by calculating LC50 values for the given test period. The LC50s are then plotted against historical values to establish organism sensitivity. If a value falls outside of the 95% confidence intervals, test variables (including food type, water composition, and temperature) are examined to isolate the potential cause of increased/decreased sensitivity. *Ceriodaphnia dubia* reproduction and fathead minnow growth are evaluated using inhibition concentration (IC25) procedures. This data is also plotted against historical data to evaluate sublethal sensitivity of the respective organism. Outliers are addressed as in

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survival analysis.

15.8 Preventative and Corrective Actions Program

Preventative Action, a pro-active process to identify opportunities for improvement in laboratory quality and efficiency, is accomplished by an on-going assessment of laboratory performance. The assessment reports employed must be broad enough in scope to detect a wide variety of potential failures in laboratory processes, methods, or procedures. On a daily, weekly, and monthly basis summary reports are generated for management assessment to monitor performance and promote improvement.

- Operational reports are inclusive of Login Summary Reports, Holding Time Status Reports, Sample Status/Completion Reports, Proposal Logs, Analysis Turnaround Time, Sample Turnaround Time, Department Turnaround Times, Client Project Updates, and Laboratory Expenditures/Orders.
- Summary reports on employees identify the analyst's turnaround time, absenteeism, vacation, and Demonstration of Capabilities/Training accomplishments. These reports are utilized to ensure that AIC staffs a sufficient number of trained personnel to meet the long term and short-term (project) analytical requirements of our clients.
- Client request/complaint along with report revision summaries serves as opportunity for improvement in performance and service.
- Quality Control Chart Evaluations and Trend Analysis reports are indicators of potential changes occurring in the analytical system for an analysis. Managers are notified of these findings in a timely manner so that preventative maintenance, instrument calibration, spiking solution evaluation, and procedural changes can be reviewed and performed prior to a system failure.
- On an on-going basis management reviews the Laboratory Information Management System (LIMS) programming for its current capabilities, efficiency of use, and the laboratory's future programming requirements with the production and documentation of quality data taking precedence in the review process.

When system deficiencies or nonconformance situations exist, corrective action procedures provide a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented Preventative Action Reports, LIMs Laboratory Corrective Action Reports, Sample Receipt Forms, Revision Summary and Corrective Action Reports..

15.8.1 **Corrective and Preventative Action Reports**

Corrective and preventative actions require management level involvement to obtain acceptable results are and implementation. These reports are used to document deviations in sample handling, analytical SOPs, client complaints, operations issues, and deficiencies found during performance evaluation sample testing. External audit deficiencies are also documented with a Corrective/Preventative Action Report.

15.8.1.1 To maintain consistency in format and information electronic templates/forms are available to all personnel in the laboratory for initiation of Corrective Action. In addition, LIMs provides for

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documentation of improvement and preventative action suggestions. Capturing the information in electronic format provides for consistent documentation, managing, categorizing, and tracking of the corrective process from initiation to completeness by the Directory of Quality Assurance and Laboratory Director.

15.8.1.2 Information components of this form are: assignment of sequential numbering; date of initiation of the corrective action; employee initiating corrective action; description of the system deficiency or nonconformance event; laboratory manager and employees directly involved in the investigation; resolution; and implementation process; sample or process affected; assignment of task with time schedule for completion; final resolution and description of preventative action to prevent re-occurrence.

15.8.1.3 Tracking components for this form are: sequential log briefly describing the reason for the corrective action and its status; a categorizing field for sorting by type of deficiency, department, analysis, and analyst; and the ability to electronically notify all individuals assigned with tasks, meeting schedules, compliance schedule, resolution, and follow-up requirements.

15.8.1.4 At a minimum, the corrective action must be signed off by the Laboratory Director and Quality Assurance Director. The Presidents signature may be required on a Corrective action, which involves a major customer complaint or an operational issue of significant impact.

15.8.1.5 Corrective action may necessitate the need to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to American Interplex Corporation. Suspension/restriction procedures can be initiated by the Director of Quality Assurance, Laboratory Director, or the President.

15.8.1.5.1 Prior to suspension/restriction, confidentiality will be respected, and the problem and the required corrective action will be stated in writing and presented to the Laboratory Director, Director of Quality Assurance and President.

15.8.1.5.2 The Laboratory Director shall arrange for the appropriate personnel to meet with the Director of Quality Assurance and the President (if available) the day of notification. This meeting shall be held to confirm that there is a problem and that suspension/restriction of the method is required. It may be necessary to sub-contract analysis to an outside laboratory (NELAC/State Regulatory Approved) to insure holding times are met.

15.8.1.5.3 The suspension/restriction meeting will conclude with a discussion of the steps necessary to bring the method, target, or test fully back on line and in compliance. The Director of Quality Assurance will also initiate and supply a copy of the corrective action report that must be completed. A copy of the meeting notes and agreed upon steps will be provided to Laboratory Director and President.

15.8.1.5.4 After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distribution through electronic means may occur. It is the responsibility of the Laboratory Director to hold all reporting. Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

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15.8.1.5.5 After 72 hours, the Director of Quality Assurance will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved can devise a start-up plan to cover all steps from client notification through compliance and release of reports.

15.8.1.5.6 Problems of a procedural/systematic nature generally require the involvement of the Laboratory Director, Director of Quality Assurance and may include that of the President. Examples might include previously reported data that has been affected by a situation requiring correction or if corrective action will negatively impact the client. If previous data is affected, the laboratory management staff is responsible for determining the significance of the problem and notifying the customer of any event that cast significant doubt on the validity of the data. This notification must be documented

15.8.1.5.7 All process and systems failures are tracked and reported to management on a monthly basis, whether or not the Laboratory Director has been directly involved with the issue.

15.8.1.5.8 The re-occurrence of the same category of problem initiates a preventative action evaluation or "Root Cause Analysis". Root cause analysis is a tool to help identify not only what and how an even occurred, but why it happened. Only when we are able to determine why an event or failure occurred can specific workable corrective measures be employed to prevent future events. In general, root causes are underlying causes, reasonably identifiable; that management has control to fix, and those for which effective recommendations for preventing reoccurrences can be generated. The use of a common statistical tool the "Cause and Effect Diagram"/Fishbone Diagram will be utilized in root cause determination by laboratory management and personnel.

15.8.2 **LIMs Laboratory Corrective Action Reports**

LIMs is used for determining and reporting an analysis non-conformance report where data does not meet quality control limits and site historical criteria. LIMs automated control charting statistically evaluates the data and notifies the laboratory, Laboratory Director, and Director of Quality Assurance that control limits were exceeded. An entire batch of samples may require corrective action if quality control criteria are not met. LIMs flags the outliers. If these are judged to need corrective action, the samples will be removed from the work list, i.e., batch, and placed in re-do status. The analyst, laboratory manager, and in some cases the Director of Quality Assurance are involved in the decisions for actions which may be inclusive of re-analysis and re-extraction, etc.

15.8.2.3Information Components of the non-conformance instances will be documented using the Laboratory Corrective Action Report generated by LIMS. The following information is provided: description of out-of-control problem; dates (date recognized, date occurred, date corrected) and sample control numbers affected; cause of problem, known or suspected; corrective action taken; resolution of problem; acknowledgement of the corrective action by the Analyst, Laboratory Manager, and the Director of Quality Assurance.

15.8.2.4Tracking Components of this database consist of each corrective action briefly describing the

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reason for the Laboratory Corrective Action Report and its status; a categorizing field for sorting by type of deficiency, department, analysis, and analyst; and the ability to electronically notify all individuals assigned with tasks, meeting schedules, compliance schedule, resolution, and follow-up requirements categorized as to the type of error. Monthly evaluation of these categories will assist in providing a long-term solution and in some circumstances will require the generation of a Corrective and Preventative Action plan for implementation of practices and policies including that of additional training.

15.8.2.5Factors that affect data quality (failure to meet calibration criteria, inadequate record keeping, miscalculations, improper storage, or preservation of samples) require investigation and corrective action.

15.8.2.6Factors assessed by control chart interpretation (see Interpretation of Control Charts in Section 15.6.5) are those of shifts, trends, biases, and data outside of control limits. The detection of one of the above conditions will be documented as appropriate on the control chart (as an outlier) and on LIMs Laboratory Corrective Action form. The out-of-control condition will then be investigated to determine whether the condition indicates a truly out-of-control situation or a possible random error. This form shall document corrective actions taken (that is, whether the sample was re-analyzed/re-calculated or whether the data was released for reporting to the client) in LIMS.

15.8.2.7A corrective action investigation is completed to determine the cause of any non-conformances or failures detected by the quality system. A systematic approach to reviewing data entry along with the associated raw data can effectively determine the cause for 95% of the corrective actions detected. The following list the categories that corrective action fall into:

15.8.2.7.1 Review of LIMS data for transcription errors.
15.8.2.7.2 Review of calculations.
15.8.2.7.3 Review of quality indicators, such as, laboratory control samples, matrix spike recoveries, and method blank performance.
15.8.2.7.4 Review of initial, continuing, and final calibration verification.
15.8.2.7.5 Review of samples for presence of matrix interferences in the sample selected as a quality indicator.
15.8.2.7.6 Review of spiking solutions for possible degradation or expiration.
15.8.2.7.7 Investigation of whether instrumental operational parameters were acceptable but near failing acceptance criteria.
15.8.2.7.8 Review of samples for possible carryover.
15.8.2.7.9 Review of samples to determine if properly preserved
15.8.2.7.10 Review of preparation logs for possible errors; and
15.8.2.7.11 Review of standards and reagents for possible errors

15.8.2.6 The EPA recommends the following guidelines for assessing acceptable data. If any data is determine to be out of control, one or all of the following should be followed:

15.8.2.6.1 Review the method with the analyst
15.8.2.6.2 Re-extract/Re-analyze the sample batch and evaluate the new results

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15.8.2.6.3 Recalibrate the instrument with freshly prepared reagents and re-analyze the samples

15.8.2.6.4 Evaluate the data and sample behavior and investigate any possible chemical interferences.

15.8.2.6.5 Check instrument for possible maintenance requirements.

15.8.2.6.6 Seek additional help from other analysts or provide additional training for laboratory personnel.

15.8.2.6.7 Perform a system audit to evaluate corrective and preventative action measures.

15.8.2.7 Corrective action implementation depends entirely upon the type of analysis, the extent of the error, and whether the error is determinant or not. Examples of determinant error are: instrument failure, replacement of contaminated extraction solvent, re-extraction and analysis of a complete batch of samples due to contamination, and re-calculation of data. Non-determinant errors will result in a complete re-analysis of sample batches, provided holding times are not exceeded. In all instances, the corrective action must be determined on a case-by-case basis. All corrective actions will be documented, and a compilation of known out-of-control situations and resolutions of problems will be established.

15.8.2.8 If an out-of-control sample is determined and the data is to be reported, the sample associated with the data is to be qualified on the final report with the phrase "the quality control data associated with [insert parameter] failed to meet acceptance criteria of [insert criteria]". The wording can differ as long as the data is flagged appropriately. Final reports cannot be generated unless corrective actions have been reviewed by the Director of Quality Assurance or her/his designee

15.8.3 **Sample Receipt Form Compliance**

Any discrepancies observed during the initial assessment are recorded on the sample receipt form generated and Chain of Custody documents. All potential problems with a sample shipment are addressed and discussed with the client. When resolved, the login process will commence; and analysis may begin. Receipt of samples exceeding the regulatory requirements for temperature, in inappropriate containers, out of holding time, or inappropriately collected as documented by the chain of custody require that a statement be included on the analytical reports that identifies any discrepancies in the transport process and that the acceptability of the data in meeting regulatory requirements may be compromised.

15.8.3.1 Environmental samples received with incomplete chain of custody documentation will be identified on the final report that documentation is incomplete. AIC will supply client a chain-of custody template and instructions for future sample submissions at the clients request.

15.8.4 **Procedure for Dealing with Complaints**

Addressing complaint is a normal function of conducting business and a valuable tool to improve services to and relationships with clients. The goal is expeditious resolution of complaints. At American Interplex Corporation the Laboratory Director, working with the Director of Quality Assurance, Project Manager, Client Services, Sample Management, and the Laboratory Section Manager(s) handles systematic problems. The Laboratory Director works with: Sample Management to resolve complaints concerning container orders, shipping, and expected report dates; with Client Services to resolve

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quote/invoicing issues; with Project and Laboratory Managers to resolve project specifications, raw data, method and regulatory requirements. The staff will document in LIMs, or on the administrative work-sheet, the client complaints, investigative finding, resolution which may be inclusive of re-analysis and reissuing a report or invoice. If the report or invoice is edited, the reissued report will so specify and indicate a description of what was edited.

15.8.4.1 A review of the data will result in one of the following scenarios depending upon the assessment:

15.8.4.1.1 If during the review process, a transcription or calculation error occurred, a revised report will be issued with the corrected result(s).

15.8.4.1.2 If, during the review process, no determinant error is detected and the sample is still available and within holding time criteria, the sample will be re-submitted for analysis. The resultant data may be reported to the client verbally or in a written revised report.

15.8.4.1.3 If, during the review process, a determinant error with the analytical process is detected and the sample is still available and within holding time criteria, the sample will be re-submitted for analysis. The resultant data will be reported to the client in a written revised report.

15.8.4.1.4 In the event that the error is not an isolated case, the laboratory shall notify all affected clients in writing that the initial data submitted is erroneous. If sample retention and holding times allow, the sample(s) will re-analyzed and an amendment to the report will be forthcoming.

15.8.4.2 In the event that the laboratory compliance with its own policies and procedures, the rules of an accrediting agency, or the validity of the data is questioned, the Director of Quality Assurance will instigate and conduct an internal audit of the areas involved and document the complaint, audit findings and recommendation using a Corrective and Preventative Action Report.

15.8.4.3 Information Components of the Customer Non-Conformance Report generated by LIMS. The following information is provided: description of out-of-control problem; dates (date recognized, date occurred, date corrected) and sample control numbers affected; cause of problem, known or suspected; corrective action taken; resolution of problem; acknowledgement of the corrective action by the Analyst, Laboratory Manager, and the Director of Quality Assurance.

15.8.4.4 Tracking Components of this Customer Non-Conformance Report database consist of a Customer Non-Conformance Log briefly describing: the reason; its current status; a categorizing field for sorting by type of deficiency (i.e. lab error, invoicing); department; analysis; and analyst; and the ability to electronically notify all individuals assigned with tasks, meeting schedules, compliance schedule, resolution. Monthly evaluation of these categories will assist in providing a long-term solution and in some circumstances will require the generation of a Corrective and Preventative Action Report (15.8.1) for implementation of practices and policies including that of additional training.

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15.8.5 Audits/Performance Evaluation Non -Conformance Reports

Corrective action documentation will also be prepared as a result of an audit finding or in the event that a Performance Evaluation sample fails to meet criteria.

15.8.5.1 Corrective actions for out-of-compliance issues from an audit are documented on the Corrective and Preventative Action section of the audit report. Internal audit findings are reviewed and acknowledged by the Laboratory Director. If audit findings cast doubt on the validity of the reported data, the client will immediately be verbally notified and a written notification will follow, when their work is affected by the findings of an internal audit. A revised report will be issued noting the affected data. Audit follow-up documentation is placed with the original corrective action documentation.

15.8.5.2 Performance Evaluation samples which fail to meet acceptance criteria are thoroughly investigated, and the likely causes for error are identified. The results of these findings, along with the corrective action taken, are documented and reported on a Corrective and preventative Action Report along with written response provided to the appropriate regulatory agencies.

15.8.6 R oles and Responsibilities

15.8.6.1 The **Analyst** must be able to recognize out-of-control conditions and immediately notify the Laboratory Manager for an action plan.

15.8.6.2 The **Laboratory Manager** must review all analytical and Quality Control data for reasonableness, accuracy, calculation errors, and completeness of records. In the event of an out-of-control analysis, the Laboratory Manager will work with the analyst to solve the problem and prevent the reporting of suspect data. The work in question will be stopped; ensuring that all results that are suspect are repeated after the source of the error is remedied.

15.8.6.3 The **Laboratory Director** is responsible for seeing that corrective and preventative action procedures are implemented provide, a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence.

15.8.6.4 The **Director of Quality Assurance (DQA)**, in the event that an out-of-control situation goes unnoticed by the above personnel, must notify the Laboratory Director, help identify and solve the problem where applicable, and ensure that the work is stopped on the analysis and that no suspect data is reported. The DQA must review and approve all corrective action reports.

15.9 Management Reviews

Annually, the laboratory's quality system (Quality Assurance/Quality Control Manual and Standard Operating Procedures) and its testing and calibration activities are reviewed and updated. This managerial review provides an opportunity for management to determine the effectiveness of the quality system and to introduce any necessary changes or improvements in laboratory operations. The review summarizes the Laboratory Managers' and the Director of Quality Assurance's assessment of quality, the results of

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inter-laboratory comparisons, proficiency tests, corrective actions, customer complaints, and other relevant factors.

A monthly QA report is prepared and submitted to the Laboratory Director and President. The report includes the frequency and number of corrective actions, revised reports, and client complaints and is used to assess the effectiveness of the quality system. Specific components of this report are

15.9.1 Audits Results of internal and external system audits performed. The number of data audits performed, percent of total packages per month plus any additional issues.

15.9.2 Revised Reports/Revised Invoices/Client Complaints section provides information on the frequency of revised reports and the total number of client complaints, issues, and resolution

15.9.3 Certification/Parameter changes are noted

15.9.4 Proficiency Testing results with identification of unacceptable results, reason, and resolution. Identification of repeat failures or significant problems must be addressed.

15.9.5 Miscellaneous QA and Operation Issues as they relate to reports, regulatory compliance issues, general concerns, and recommendations for change.

15.10 Data Review and Validation

The review of data quality involves several levels of evaluation. In general, the analysts and the Laboratory Managers will be responsible for reviewing and validating the data relative to instrument calibration, standard preparation, method blanks, raw data, calculations, and transcriptions. When evaluating batch QC the analyst makes a sequence of decisions before reporting samples results regarding calibration, the method blank, LCS, surrogate recovery, matrix spike and matrix spike duplicate recovery results. The first evaluation of acceptability is made according to the requirements stated in the method. The second is based upon any special project requirements. Appendix III and IV presents a summary of the definition, purpose, and evaluation of the major quality control checks required for the various methods along with flow charts used in data review and validation.

Additional verification by the Director of Quality Assurance will be accomplished through routine audits of the data collection and flow procedures and by monitoring; the results of Quality Control check samples. The minimum review and validation requirements for each audit conducted by the Director of Quality Assurance include the following:

- Three point calibration and one calibration check standard, or as method appropriates
- Continuing calibration check using an EPA or NBS reference
- Quality control check sample included in each analysis whenever available

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- One reagent blank per matrix and per concentration level for every sample batch analyzed (that is, one per 20 samples)
- Review of each Quality Control check sample, spike, matrix spike, and matrix spike duplicate, duplicate per concentration level, and per matrix for every sample batch analyzed that is, one per 20 samples)
- Review of sample documents for completeness by the analyst(s)at each step of the analytical process.
- Review of instrument logs, performance test results, and analysts' performance
- Review of the performance indicators (blanks, surrogate recoveries, duplicate/matrix spikes)
- Random calculation checks
- Review of data with emphasis on the reasonability, significant figures, and analysis detection limit

The emphasis will be on the data acceptability relative to the data quality indicators and the accuracy of the final data summaries. All analytical problems encountered during the sample analysis will be properly addressed, documented, and resolved. Non-compliance and/or QC failures are reported on the final report in the remark and note sections.

15.11 Data Assessment/Validation Process Flow Diagrams

The following flow diagrams for the quality assurance/quality control data validation and assessment process depicts how precision and accuracy data are created and utilized. The individual steps in the data validation and assessment process are inclusive of all numerical computations/formulas for ease of use by the American Interplex Corporation technical staff.

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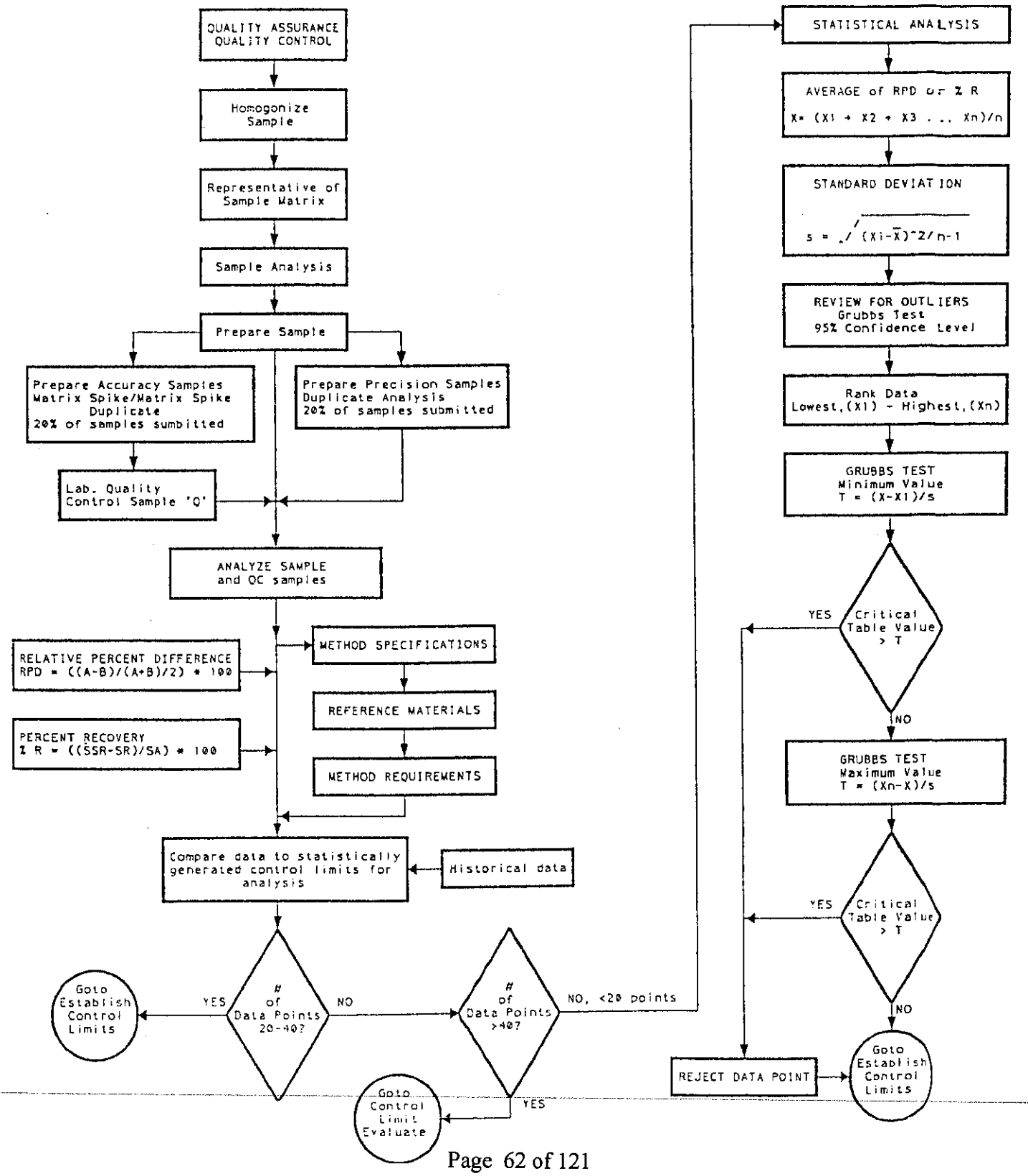
DATA ASSESSMENT AND VALIDATION PROCESS


QUALITY ASSURANCE QUALITY CONTROL
Homogonize Sample
Representative of Sample Matrix
Sample Analysis
Prepare Sample
Prepare Accuracy Samples Matrix Spike/Matrix Spike Duplicate 20% of samples sumbitted
Prepare Precision Samples Duplicate Analysis 20% of samples submitted
Lab. Quality Control Sample 'Q'
ANALYZE SAMPLE and QC samples
RELATIVE PERCENT DIFFERENCE RPD = ((A-B)/(A+B)/2) * 100
PERCENT RECOVERY % R = ((SSR-SR)/SA) * 100
METHOD SPECIFICATIONS
REFERENCE MATERIALS
METHOD REQUIREMENTS
Compare data to statistically generated control limits for analysis
Historical data
YES
# of Data Points 20-40?
NO
# of Data Points >40?
NO, <20 points
Goto Establish Control Limits
Goto Control Limit Evaluate
YES
STATISTICAL ANALYSIS
AVERAGE of RPD or % R
X= (X1 + X2 + X3 . . . Xn)/n
STANDARD DEVIATION
s = √ (Xi-X̄)^2/n-1
REVIEW FOR OUTLIERS Grubbs Test 95% Confidence Level
Rank Data Lowest,(X1) - Highest,(Xn)
GRUBBS TEST Minimum Value T = (X-X1)/s
YES
Critical Table Value > T
NO
GRUBBS TEST Maximum Value T = (Xn-X)/s
YES
Critical Table Value > T
NO
REJECT DATA POINT
Goto Establish Control Limits

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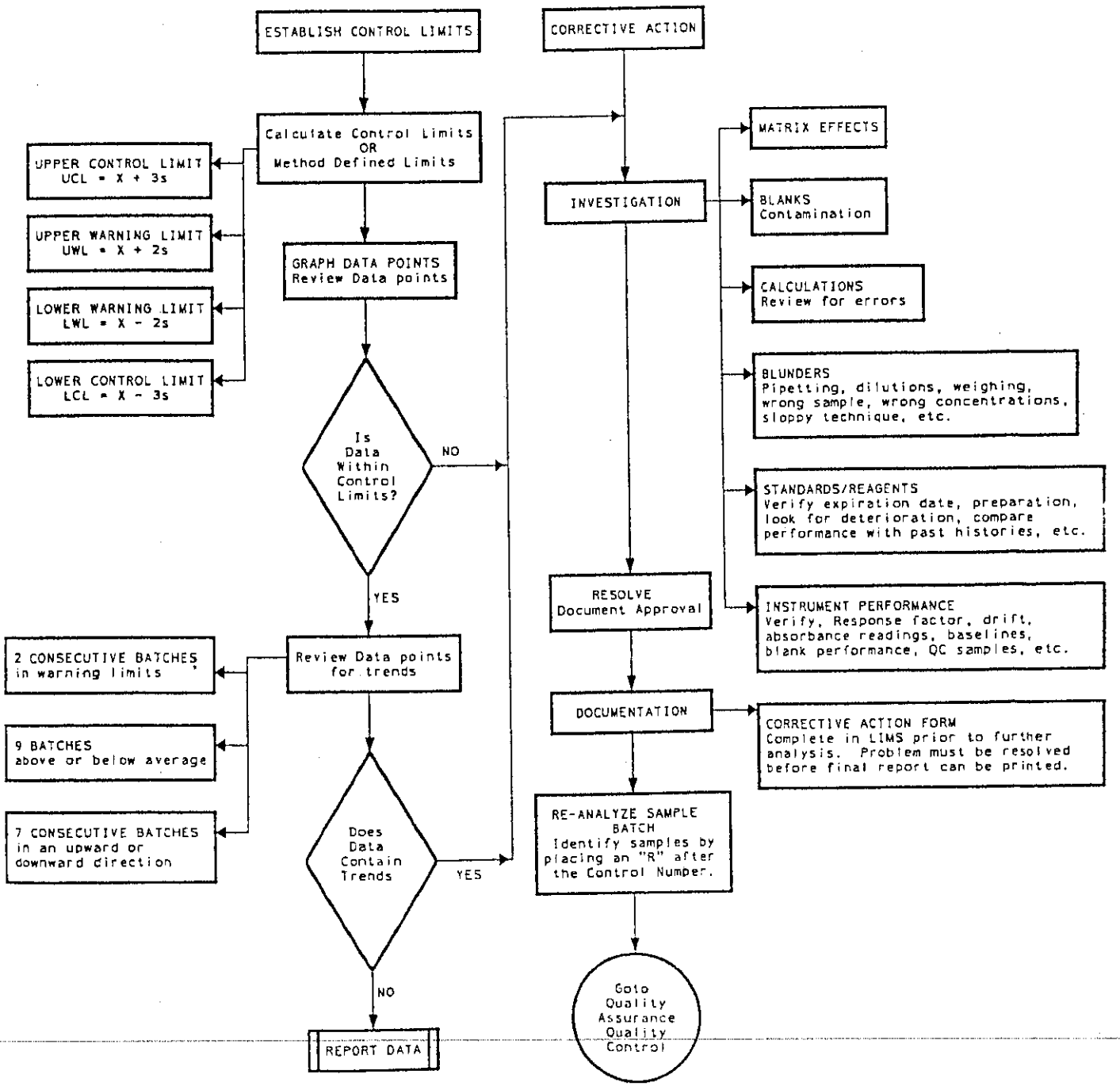
DATA ASSESSMENT AND VALADATION PROCESS
(continued)


ESTABLISH CONTROL LIMITS
Calculate Control Limits OR Method Defined Limits
UPPER CONTROL LIMIT UCL = X + 3s
UPPER WARNING LIMIT UWL = X + 2s
LOWER WARNING LIMIT LWL = X - 2s
LOWER CONTROL LIMIT LCL = X - 3s
GRAPH DATA POINTS Review Data points
Is Data Within Control Limits?
NO
YES
Review Data points for trends
2 CONSECUTIVE BATCHES in warning limits
9 BATCHES above or below average
7 CONSECUTIVE BATCHES in an upward or downward direction
Does Data Contain Trends
YES
NO
REPORT DATA
CORRECTIVE ACTION
INVESTIGATION
MATRIX EFFECTS
BLANKS Contamination
CALCULATIONS Review for errors
BLUNDERS Pipetting, dilutions, weighing, wrong sample, wrong concentrations, sloppy technique, etc.
STANDARDS/REAGENTS Verify expiration date, preparation, look for deterioration, compare performance with past histories, etc.
INSTRUMENT PERFORMANCE Verify, Response factor, drift, absorbance readings, baselines, blank performance, QC samples, etc.
RESOLVE Document Approval
DOCUMENTATION
CORRECTIVE ACTION FORM Complete in LIMS prior to further analysis. Problem must be resolved before final report can be printed.
RE-ANALYZE SAMPLE BATCH Identify samples by placing an "R" after the Control Number.
Goto Quality Assurance Quality Control

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15.12 Departures from Policies and Standard Operating Procedures

When requests for modification to an SOP (such as a change in reporting limit, addition or deletion of target analyte(s), etc.) are received, the proposed deviation must be approved by the Laboratory Director. The Laboratory Director has the responsibility for ensuring the appropriate project requirements are in LIMS.

When a deviation or departure from Company policies or procedures is necessary, approval from the Laboratory Director is required. These departures may occur for the analysis of an analyte for which a method has not been defined and a method modification is necessary or for an atypical matrix. In these situations, AIC standard QC samples (blank, laboratory control sample, sample duplicate, and matrix spike) should be initially employed for data validation. The results of these samples will be technically evaluated on an individual bases by the Laboratory Director(s)and reviewed by the Director of Quality Assurance. Further method development may be necessary prior to reporting of the data; or, if continual submission of similar samples is anticipated, standard operating procedures will need to be developed. Where appropriate, data qualifiers will be provided on the final report and method modifications will be noted.

Frequent departure from policy is not encouraged. However, if frequent departure from any policy is noted, the possible need for a change in policy will be addressed by the Laboratory Director.

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- If the figure following those to be retained is greater than five (5), the figure is dropped; and the last retained figure is raised by one (1). As an example, 11.446 rounds off to 11.45.

- If the figure following those to be retained is five (5), and there are no figures other than zeros beyond the five (5), the figure five (5) is dropped; and the last-place figure is increased by one if it is an odd number, or it is kept unchanged if it is an even number. As an example, 11.4350 rounds to 11.44, while 11.4250 rounds off to 11.42.

16.5 Data Assembly and Reporting

The Laboratory Information Management System (LIMS) is able to track and control the movement of samples from time of receipt through disposal. Data assembly and reporting are initiated at the time of sample receipt and completed during the invoicing and mailing procedures.

At login, LIMS assigns a unique laboratory control number to each sample received, generates a data management file and a hard copy printout, and prints associated sample labels. Every file contains the name of the client; reporting and billing addresses; project references; purchase order numbers, if provided; current proposals; special instructions; date of sample receipt; date sampled if provided; analytical requirements; Chain of Custody documentation; and, when applicable, the proposed date of completion.

Verification of sample identification on containers with that of Chain of Custody documentation is conducted by the Sample Custodian. Further review by management ensures that the appropriate methodology has been initiated, all the information is correct, and the Chain of Custody documentation has been completed. After review, all documentation is forwarded to the word processing center to await final compilation and reporting. As samples are logged in, each laboratory is notified immediately of holding times, expedited analyses, and special handling instructions. An integrated electronic mail system is also used to allow communication between personnel concerning samples and analyses.

LIMS routes analyses to each specific laboratory and generates departmental work lists from which samples can be batched. The analyst designates Quality Control samples within batches, which are given unique sample numbers. Both the samples and the Quality Control can be tracked through the various stages from preparation to completion. A query can determine what stage, the analysis is in, which QC belongs with which samples, and the date and time analysis was initiated.

Data is entered into LIMS by electronic transfer when instrument interface capabilities exist or by manual entry by analysts. The system is fully GALP compliant, as LIMS tracks who entered the data, what changes the data went through, who edited the data, the times of all changes, and reasons the changes took place. As data is entered, the analyst identifies any sample non-compliance and/or QC failures that apply to the reported results by adding the appropriate comment to the sample specific notes or to the remarks section of the report. To standardize the case narrative section of the report, the analyst can select or modify one or more of the pre-programmed annotations found in LIMS. As results become avail-

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able, information can be accessed by laboratory management.

When all analyses have been completed for a control number, a list of completed jobs will automatically be printed by LIMS for final reporting. The final report and invoice is generated, reviewed, and authorized by the laboratory director(s) and forwarded to office personnel for the mailing process. The client will receive an original report containing the result of the analyses plus comments, where appropriate. A hard copy will be retained in our laboratory for 10 years.

Each parameter reported will be referenced to a methodology, batch number, date and time of analysis, and analyst(s). Retrieval of data is possible by client name or sample control number. Through this system of record keeping, the original data and any corrections can easily be located. Reasons for all changes of data are documented--including the date and time stamp with the analyst's unique number following Good Automated Laboratory Practice (GALP) guidelines.

No information will be given to non-client parties unless a request of release is provided by the client. Confidentiality of analytical data is strictly protected.

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